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RETENTION OF FLYING SKILLS AND REFRESHER TRAINING REQUIREMENTS: EFFECTS OF NON-FLYING AND PROFICIENCY FLYING

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Human Resources Research Organization

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A questionnaire survey was conducted of Army aviators who had experienced extended periods of nonflying or of flying only the minimum number of hours required by Army regulations to maintain proficiency, in order to determine the loss of flying ability experienced and the refresher training required for combat readiness. Analysis of the data obtained indicated that flight excusal followed by refresher training would provide

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operational units with better qualified aviators at less cost than the traditional flying program. A proficiency maintenance program based on very low-cost synthetic training devices seems to be the only alternative that might be less costly than excusal plus refresher training, but feasibility of these devices in the Army context is unknown at this time.

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Report
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Retention of Flying Skills and Refresher Training Requirements: Effects of Nonflying and Proficiency Flying

Robert H. Wright

HumRRO Division No. 6 (Aviation)
Fort Rucker, Alabama

HUMAN RESOURCES RESEARCH ORGANIZATION

Exploratory Research 84

December 1973

Prepared for

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The Human Resources Research Organization (HumRRO) is a nonprofit corporation established in 1969 to conduct research in the field of training and education. It is a continuation of The George Washington University Human Resources Research Office. HumRRO's general purpose is to improve human performance, particularly in organizational settings, through behavioral and social science research, development, and consultation. HumRRO's mission in work performed under contract with the Department of the Army is to conduct research in the fields of training, motivation, and leadership.

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FOREWORD

This report describes the results of a survey performed for the Department of the Army by the Human Resources Research Organization (HumRRO), as a part of Exploratory Research 84. The objective was to determine the loss of flying ability during, and the refresher training requirements after, extended episodes during which Army aviators did no flying, or flew only the minimum number of hours required to maintain proficiency as prescribed by Army regulations.

The research was performed at HumRRO Division No. 6 (Aviation), Fort Rucker, Alabama. Dr. Wallace W. Prophet is Director of the Division. Dr. Robert H. Wright was responsible for the conduct of this research. Mr. D. Schley Ricketson participated in the development and conduct of the survey.

Military support was provided by the U.S. Army Aviation Human Research Unit while LTC Robert O. Carter was the Unit Chief. LTC Donald E. Youngpeter is the present Unit Chief.

The cooperation of the aviators who completed the survey and of the administrative personnel in many Army aviation units was an essential factor in collecting the data upon which this report is based.

The ER-84 research for the Department of the Army was conducted under Contract DAHC 19-73-C-0004. Army Training Research is performed under Army Project 2Q062107A745.

Meredith P. Crawford
President
Human Resources Research Organization

MILITARY PROBLEM

With the reduction in Vietnam hostilities, large numbers of Army aviators were given nonflying duty assignments. Proficiency flying has traditionally been required in such assignments. However, the specific restrictions on proficiency flying that have been enacted, and the reduced funding available, necessitate limitations on the amount of proficiency flying performed by Army aviators. The consequences to flying skills and refresher training requirements of reducing or eliminating proficiency flying have not been defined quantitatively by any of the services, and no data exist for helicopter pilots. Such data are needed to enable the Army to determine the lowest-cost proficiency flying and aviation combat readiness training that would be compatible with operational readiness objectives.

RESEARCH OBJECTIVES

The objective of this research is to obtain information on the rates of loss of various types of flying skills by Army aviators, and the refresher training necessary to reacquire flying proficiency following episodes of proficiency flying or flight excusal for periods of up to three years. The Army requested data on the effects of three background variables and seven specific questions related to combat readiness training policy planning.

RESEARCH APPROACH

A survey of pilots who had experienced extended periods of flight excusal or proficiency flying status was used to obtain data to answer the questions raised. The survey questionnaire obtained comprehensive data on the flying experience of each responding aviator. The aviator was asked to recall data on his flying ability before the episode of nonflying or proficiency flying that he had experienced, and his ability after the episode and the refresher training that was required.

There were 58 usable questionnaires obtained from aviators who had experienced an extended period of flying excusal, and 117 were obtained from aviators who had experienced an extended period of time during which they flew only the number of hours (minimums) that were required to maintain flying status.

FINDINGS

(1) For Army aviators who had standard instrument ratings, the data obtained indicated that:

(a) In comparison with nonflying periods, flying minimums resulted in a slightly lower rate of loss of flying skill and a slightly lower total loss of flying skill for any given length of episode. Minimums reduced loss of visual flying rules (VFR) skill by 20%, and instrument flying rules (IFR) loss by 10%.

(b) Practically all (90%) of the loss in flying ability that occurs over extended periods of time occurs within 12 months. After 12 months, flying ability and refresher training required remain practically constant.

(c) At the start of episodes of nonflying or flying minimums, flying ability on skills under VFR was reported as being considerably better than on IFR. The rate of loss in flying ability was about the same for VFR and IFR skills; but, since the levels of ability were quite different at the start of the episode, it can not be concluded that these rates of deterioration in VFR and IFR flying skills would be the same if equal beginning ability existed. The form of the retention curves suggests that IFR skills would deteriorate more rapidly if IFR ability at the start of the episode was equal to ability on VFR skills.

(d) For aviators who did no flying as well as for those who flew minimums, ability on VFR flying skills remained above the minimum acceptable level of ability that was required to graduate from the initial entry flight-training course. However, on IFR flying skills, about one-half of the aviators (50% of those not flying, 40% of those flying minimums) dropped below this minimum acceptable level of ability after 12 months—and flying minimums had only a small effect on this proportion.

(e) After one year, flying minimums reduced the refresher flight instruction required for resumption of pilot-in-command flying duties to an average of 12 hours, compared to the 19 hours required by aviators who did not fly at all.

(f) After one year, flying minimums reduced the refresher flight instruction actually received to 6.5 hours from 8.5 hours for the nonflying group.

(2) In terms of refresher flight instruction actually received by all the respondents:

(a) Proficiency training in light proficiency aircraft reportedly increased refresher training time required by about one hour over that required after not flying at all (8.0 vs. 6.8 hours), while proficiency training in operational aircraft reduced refresher training by one and one-half hours (5.4 vs. 6.8 hours).

(b) There was no significant difference between fixed- and rotary-wing aircraft in the amount of refresher flight instruction received.

(c) The effects of flying experience on refresher flight instruction received indicate a general trend of both very inexperienced and more experienced pilots receiving less refresher training than pilots of moderate experience (7 to 36 months or 500 to 2,000 hours). Moderate-experience pilots averaged around 7.5 hours refresher flight instruction, while both very inexperienced and more experienced pilots received an average of about 4.5 hours. There was some indication of a continuing slow decline in refresher training required with experience for highly experienced pilots. The reduced refresher training for very inexperienced pilots can be attributed to the close supervision such aviators would usually receive after joining a unit.

(3) The data obtained indicate that a program of flying excusal followed by refresher training should be considerably more economical and effective in providing proficient aviators to operational units than would a program of periodic proficiency flying as it has been performed in the past. If a program of periodic flying is used, the data indicate that intervals of not more than six months should exist between periods of training in IFR skills that would bring aviators back up to fully competent levels of ability. No periodic training on VFR skills would be needed over three-year intervals to maintain ability equal to or above that required for graduation from the initial entry flight-training course.

CONCLUSIONS

(1) Proficiency flying as typically performed in the past has not been effective in maintaining flying skills at high levels of proficiency. Large losses in flying ability occurred whether or not proficiency flying was performed.

(a) VFR flying skills generally remained acceptable for up to three years without any flying.

(b) IFR flying skills became less than acceptable after one year for nearly one-half the Army aviators surveyed, even if minimums were flown.

These data indicate that IFR flying skills should receive primary emphasis in proficiency or refresher training, and that such training should be highly structured to assure that maximum training value is realized.

(2) The typical retention curves found for other skills were also found for flying skills, with the highest losses occurring soon after training and experience. These loss rates of flying skills decrease to nearly zero after one year. The retention curves can be exploited administratively to reduce proficiency and combat readiness training costs in various ways, but they clearly indicate that the higher levels of flying ability will be maintained only through regular and frequent synthetic training or actual flying experience.

(a) After 12 months of flight excusal, refresher training requirements remain about the same for longer periods of time, such as two or three years. The shape of the curves suggests that any training six months or more prior to resuming operational flying duties will have little value.

(b) To continually maintain a minimally acceptable level of flying ability, refresher training to bring aviators up to standard would be required at least every six months.

(3) The slight increase in refresher training time required when simple light aircraft were used in proficiency flying indicates that the compatibility of aircraft configuration used for proficiency and refresher training is a factor that merits close consideration in the management of proficiency training. It needs to be recognized that flying different aircraft for proficiency than those used for refresher training may actually interfere with certain flying skills (where to look and reach, in particular) due to differences in crew station configuration or procedures. Compatibility of configuration and procedures seems to be a critical factor in proficiency training of experienced pilots that has not received sufficient recognition.

(4) Since only a small amount of refresher flight training is required after flight excusal, only extremely low-cost synthetic training devices, not now available in the Army (but available in the civil general aviation market), appear to have any potential of providing periodic proficiency training at less cost than refresher training alone, after two- or three-year excusal periods. The proficiency training value of these very low cost training devices has not been determined for Army aviation applications. Comparison of the training value of these devices with that of actual flying and with more complex synthetic training devices is needed to provide the data required for the tradeoffs that need to be considered in defining the most effective and lowest-cost program for attaining aviator proficiency and combat readiness objectives. If these very low-cost synthetic training devices do not have significant training value, probably the lowest-cost program for providing operational units with proficient aviators would involve flight excusal followed by refresher training just before or upon assignment to an operational unit.

(5) The data obtained suggest that IFR training in a specific aircraft configuration may alone be sufficient to maintain an acceptable (but not highly proficient) level of overall flying ability in that aircraft. If so, it is probable that a synthetic training device in the configuration of that aircraft could also be used to maintain this acceptable level of flying ability.

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Retention of Flying Skills and Refresher Training Requirements: Effects of Nonflying and Proficiency Flying

Chapter 1

INTRODUCTION

OBJECTIVES

Little factual information exists regarding the effects of proficiency flying on retention of flying skills and refresher training requirements. Much of the available data is based upon, or could have been influenced by, pilot opinion—making it a poor basis for management decisions regarding proficiency flying programs. For several reasons the number of Army aviators in nonflying assignments has recently increased substantially, a practice likely to continue for at least several years. At the same time, funding limitations have made it difficult to provide the increase in aircraft and other resources needed to accommodate this increased proficiency flying requirement. Congress has recently restricted proficiency flying in certain types of assignments.[1]

The lack of acceptable data on the effects of nonflying and proficiency flying on flying ability and refresher training makes it difficult to determine the impact of various potential proficiency flying and Combat Readiness Flying (CRF) training policies on overall combat readiness and costs. It is the purpose of this study to provide a set of data that should improve confidence in determining an optimum proficiency flying and CRF policy for Army aviators.

No data directly relevant to the Army aviator proficiency flying situation are available in the literature. Available laboratory data have been reviewed.[2] These data indicate that the perceptual-motor skills involved in aircraft control should be retained well and regained rapidly, while procedural skills should be prone to loss and require emphasis in retraining. No data reasonably pertinent to loss and reacquisition of the complex, integrated, whole-task skills of the proficient pilot were found in the literature. A recent review on the degradation of learned skills (1) reached the same conclusion as regards complex flying skills.

Several reports (2, 3,) indicate that most Air Force and Navy pilots generally "feel they should" and "want to" perform proficiency flying when not in an operational flying assignment. Furthermore, the general consensus is that they would prefer to perform this proficiency flying in first-line combat aircraft. Although no detailed quantified information on the effect of proficiency flying on refresher training requirements in these services was found, various observations make it appear that the impact of usual CRF flying is only a few hours on the refresher training received prior to rejoining an operational unit. It also seems probable that the impact of usual proficiency flying in a first-line combat aircraft would only moderately reduce replacement training below normal refresher flight hours.

Army warrant officer aviators seem comparable to Air Force and Navy pilots in their attitude toward proficiency flying; both groups tend to regard themselves primarily as professional pilots. In contrast, the commissioned Army aviator generally tends to regard his role as officer/soldier as primary, and his flying duties as secondary. Therefore,

[1] Public Law 92-204.

[2] Behavioral science research data relevant to Army proficiency flying programs was reviewed by Robert H. Wright, HumRRO, in 1969.

it is reasonable to expect the Army aviator commissioned officer to have somewhat different attitudes about proficiency flying when there is the potential of this flying interfering with the performance of what he considers to be his primary duties. Comparison of available evidence (4, 5), although limited, supports this analysis with indications that relatively small percentages of commissioned Army aviators would leave the Army as a career because of the lack of opportunity for proficiency flying. (It should be noted, however, that concurrent removal of flying pay might have a more significant impact on retention.)

A conclusion from the above is that elimination of annual minimums during nonflying assignments is a proficiency flying and CMF option that merits close consideration. The savings in CMF resources and numbers of accidents would be major advantages, provided these savings would not be negated by increases in refresher training costs or unacceptable reductions in combat flying readiness.

In many flying assignments, the actual flying required may be considerably less than required annual minimums, with the consequence that these minimums increase unit flying hours above those necessary to perform the unit mission. A policy such as "recency of experience in type" prior to performing as pilot (similar to civilian requirements) might reduce flying hours and provide better and safer pilots when they do fly than would the many hours of "boring holes in the sky" to meet annual minimums.

The primary focus of this study was to obtain information on the rates of loss of various types of flying skills by Army aviators, and the refresher training needed to reacquire flying proficiency following episodes of proficiency flying or flight excusal. The Department of Army request for this study provided specific guidance as follows:

Scope. specific topics for separate investigation of the fixed-wing and rotary-wing aviators are to be based upon the following general qualifications:

(1) Twelve, 24-, and 36-month periods of nonflying.
(2) Aviator experience of three, seven, 11, and 15 years' service as a rated pilot.
(3) The required proficiency level for operational flying duty is that level required for graduation from the U.S. Army Aviation School (either fixed-wing or rotary-wing) initial entry flight course.

Questions to be answered for each combination of experience and non-flying time are:

(1) What type of aviation skills most rapidly deteriorate during periods of non-flying?
(2) What is the extent of this deterioration?
(3) What are the requirements for refresher training to re-establish the aviator's original proficiency level following the various non-flying periods?
(4) Will periodic flying during the non-flying tour of duty materially affect the aviator's proficiency and reduce refresher training requirements?
(5) If periodic flying is recommended, at what interval and how much flying should be accomplished?
(6) Does flying relatively simple, light aircraft contribute to proficiency in sophisticated complex aircraft?

(7) What is the comparison of refresher training requirements for non-flying, periodic flying of light proficiency aircraft, and periodic flying of operational aircraft?

APPROACH

Survey and Sampling Considerations

The selection of the survey approach for conduct of this study was dictated by a combination of factors. Primarily, the survey approach was the only practical means for providing any meaningful data within a period of about one year. Consideration of all factors indicated that a survey would also provide the most accurate answers short of a long-term, large-scale, costly effort of in-flight performance measurement. When it became evident that the study would have to be limited to approximately a one-year period, activities directed toward consideration of in-flight or simulator performance measurement were discontinued, and all effort was directed toward obtaining maximally useful data through a survey approach.

Difficulty in obtaining access to subjects who were terminating one- to three-year nonflying episodes was one major deterrent to using the direct in-flight measurement approach. At the start of the effort, it appeared that there were less than a dozen potential subjects in the Army, and access to them for testing prior to any refresher flight training appeared difficult to control. Controlling assignment of a pilot in a nonflying status for periods of up to three years, although administratively possible, also appeared difficult to achieve with an acceptable level of confidence because of personnel management considerations. Therefore, in addition to the length of time the study would have to take and the need to develop new in-flight pilot performance measurement techniques, control of the test subject population appeared to represent a significant risk in a long-term, direct, performance-measurement approach.

No practical way to identify aviators who had experienced an extended period of nonflying could be determined; and, in fact, no way was found to estimate the number of aviators in the Army who might have experienced such episodes. On the basis of informal estimates, however, it was judged that there should probably be at least several hundred aviators who had experienced these nonflying episodes at some time in their careers. If these aviators could be reached, their actual experiences regarding refresher training requirements and loss of flying skill caused by the episode might form a reasonably sound basis for estimating the effects of such an episode on Army aviators. Their ability to recall the actual refresher training they required after the episode, in particular, could be expected to be accurate within a few hours in most cases. Such recall based upon actually experiencing the situation could be expected to be much more accurate than guesses by aviators who had not actually had the experience. (It should be noted that a potentially large group of subjects in nonflying status in U.S. Continental Army Command (CONARC) schools at the time of this survey could not be used, because they had not completed their schooling or had not completed their refresher flight training.)

In addition to subjects who had not flown at all for an extended period of time, a second group of subjects who had flown only the CRF proficiency flying prescribed by regulation was also needed to serve as a comparison or "control group" and to answer questions regarding the effect that was produced by the type of aircraft used in flying minimums. Because of the uncertainty regarding the number of "no flying" subjects who were available or who would respond, a third, "no instrument flying" category of subjects was included in the survey as a backup for use in the event that a sufficient

number of responses could not be obtained from "no flying" subjects. Since enough "no flying" subjects were obtained, it was not necessary to resort to the partial answers that would have been provided by these "no instrument" subjects, and the results for them will not be considered in this report.

Since there was no way of identifying sufficient potential subjects from available records, a "shotgun" sampling approach was selected for obtaining subjects. The units and locations where large numbers of Army aviators were assigned were identified, and survey forms were sent to them with instructions that aviators with pertinent experience be identified and requested to complete the survey. The number of usable surveys returned by this sampling approach was considered sufficient to provide answers to the primary questions of the study. Therefore, follow-up sampling plans for obtaining additional subjects were not pursued.

The survey forms returned were screened to eliminate those that were unusable or not applicable to the selection criteria for inclusion in the sample to be used for analysis. Among those subjects excluded from the sample were (a) pilots who immediately after the episode had entered a transition or other formal course in which the training was based on a standard curriculum rather than required on the basis of proficiency (if a pilot was not qualified in the aircraft used for refresher training prior to the end of the episode, he was excluded); (b) pilots who had not completed the nonflying or minimum only episode prior to answering the survey (if a pilot had not actually completed his refresher training after the episode, he was excluded); (c) pilots whose length of episode was less than six months, or could not be determined; and (d) certain respondents whose answers did not conform with the criteria used for refresher training, such as those who listed all flying done over several years since the episode.

Statistical Confidence Criteria

The usual scientific criterion of statistical significance, .05—that is, expectation of chance occurrence of a result less than one time in 20—was not considered appropriate for application to most of the questions of this study. If an obtained difference could be expected by chance one time in five, the users of the obtained data probably would consider these odds sufficient for practical significance. Any result likely to be obtained on less than a pure 50-50 chance basis may be of value in the decisions required regarding CRF policy.

When a "significant difference" is reported in this study, therefore, the usual .05 criterion is not implied. Any difference likely to occur by chance less than one time in five will be treated as statistically significant ($p<.20$) in the results. Usually a specific or general indication of the level of significance, or the difference required for a given level of significance, will be indicated. When the term "no difference" is used, the actual difference would be expected to be exceeded by chance more than one-half of the time.

Use of this relaxed criterion for significance increases the chance of error in accepting a difference when none actually exists, but reduces the chance of error in concluding that no difference exists when one actually does.

For most users of the study results, a lack of difference between groups is likely to be of greater interest from a practical standpoint than large differences between groups in the expected direction. Since the results of this study generally indicate a "no difference" situation, the confidence that "no difference" really exists will be the major concern in interpretation of the results.

THE SURVEY

The survey consisted of two major sections. (A copy of the headings for which data were obtained in the survey is shown in Appendix A.) The first section was divided into

four parts (Parts I, II, III, and IV), and obtained background information about the respondent with emphasis on the type and amount of his flying experience. The second section (Part V) obtained data on flying ability and refresher training required on 20 categories of flying skill, and provided the criterion measures used in this study. The 20 skill categories used and the definition provided for each are listed in Table 1.

The background information in the first section was used to define groups of subjects corresponding to the questions of concern in this study, and the second section criterion data for these groups were statistically summarized to determine the differences between groups. The criterion measures obtained in the second section are described in greater detail below.

CRITERION MEASURES

Four ratings of flying ability were used as criterion measures:

Criterion Measures 1 to 4

(1) Flying ability rating when initially rated
(2) Flying ability rating before episode
(3) Flying ability rating after episode
(4) Drop in ability during episode (derived from 2 and 3)

Ability ratings were made on an 11-point scale anchored with ability descriptors (see Figure 1). The critical anchor descriptor for this study was the "Just Adequate" Category 3, which was defined to correspond with the minimum ability required for graduation from the initial entry flight training course. This level of skill was suggested in the DA request for the study as the ability criterion for performance of operational flying duties, seemed to be appropriate from the technical research standpoint, and was considered to be the ability descriptor subject to the least variability in interpretation among those considered as scaling anchors. Another important anchor was Category 5, "Clearly Adequate," which was defined as the minimum ability sufficient for assignment as pilot in command of an aircraft without direct supervision. The scale was designed so that use of the top and bottom categories of the scale would be very infrequent. The distribution of ability ratings for the first item on each skill, "When First Rated" as an aviator, provided a basis for comparison and evaluation of use of the scale.

As can be seen in Figure 2, the distribution for overall flying ability when first rated clusters near the center of the scale with Category 4, "Adequate", used most frequently, and no ratings below the 3, "Just Adequate" category, which represents the minimum level of skill defined as required for performance of operational flying duties. This conforms with expected usage of the scale and lends credence to the conclusion that ability ratings falling below Category 3 represent a level of flying skill less than the minimum ability criteria established for performance of operational flying duties. It may be noted, however, that a number of respondents rated their initial flying ability quite high. Most of these pilots would appear either to have an inflated opinion of their flying ability, or to be following traditional Army evaluation practices in which any ratings less than "Superior" may be interpreted unfavorably.

The ratings for Overall Flying Ability before the episode show the pattern of ratings shifted higher, as would be expected, with ratings of "Competent" and "Highly Competent" used most frequently. In general, distribution of responses on the ability rating scale conforms closely with that intended and expected, and acceptance of the data from it appears warranted as a reasonable approximation to the actual state of affairs in regard to flying ability on a skill.

Table 1

List of Skills With Descriptors

ITEM V. OVERALL FLYING ABILITY. Knowledge, judgment, and skill in the aircraft an f other abilities of a pilot which enables him to safely and effectively accomplish all those missions which are potentially possible, considering the aircraft/instrument configuration and his ratings.

ITEM V.1. OVERALL VFR FLYING ABILITY. Knowledge, judgment, and skill in the aircraft and other abilities of a pilot which enable him to safely and effectively accomplish all those missions which are potentially possible in VFR conditions in the aircraft.

ITEM V.2. OVERALL IFR FLYING ABILITY. Knowledge, judgment, and skill in the aircraft and other abilities of a pilot which enable him to safely and effectively accomplish all those missions which are potentially possible in IFR conditions, considering the aircraft/instrument configuration and his ratings.

ITEM V.3. KNOWLEDGE OF THE AIRCRAFT AND PREFLIGHT PROCEDURE. Knowledge of the aircraft and its systems, and knowledges, judgment, and skill involved in planning a mission and starting and checking out the proper condition and functioning of the aircraft and its systems.

ITEM V.1.a. VFR BASIC MANEUVERS. Knowledge of how all basic VFR maneuvers, from takeoff to landing, should be performed; and the ability to perform them according to accepted operational practices.

ITEM V.1.g. ARMY AND CIVIL REGULATIONS FOR VFR OPERATIONS. Knowledge and application of Army and civil regulations pertaining to enroute and terminal area operations of aircraft in VFR conditions.

ITEM V.2.a. IFR BASIC MANEUVERS. The ability to perform all basic IFR maneuvers, from takeoff to landing, basing aircraft control on the interpretation of information obtained only from instruments within the aircraft.

ITEM V.2.b. ARMY AND CIVIL REGULATIONS FOR IFR OPERATIONS. Knowledge and application of Army and civil regulations pertaining to enroute and terminal area operations of aircraft in IFR conditions.

ITEM V.2.c. IFR TERMINAL APPROACHES AND DEPARTURES. Knowledge of, and proper interpretation and execution of, the procedures published in standard terminal approach and departure plates, as directed by the tower and ground controllers.

ITEM V.2.d. IFR CROSS-COUNTRY—DAY AND NIGHT. Ability to control the aircraft and its performance by reference to instruments in compliance with appropriate flight rules, regulations, and instructions; and to utilize navigation aids to determine aircraft position and maintain desired course.

(Continued)

Table 1 *(Continued)*

List of Skills With Descriptors

ITEM V.1.b. VFR CROSS-COUNTRY—DAY AND NIGHT. Ability to maintain a desired course by determining and executing required changes in attitude and heading through proper use of terrain features, maps and charts, computers, navigation instruments, etc., and to properly execute VFR approaches and departures from air terminals.

ITEM V.1.c. VFR ADVANCED MANEUVERS/OPERATIONS (e.g., Confined Area, Short Strip, External Loads). Ability to plan and execute approaches and takeoffs from confined/difficult landing sites. For helicopters, includes ability to plan and execute external load or other hovering operations where landings are not feasible or desirable.

ITEM V.1.d. VFR POWER LIMITED OPERATIONS. Ability to plan and execute basic and advanced maneuvers when temperature and/or load requires operation near or at the limits of available power.

ITEM V.1.e. VFR LOW LEVEL FLIGHT AND NAVIGATION. Ability to fly with maximum safety at low and nap-of-the-earth terrain clearance levels, and to determine the aircraft's position and direct it to a destination at these clearance levels.

ITEM V.1.f. VFR EMERGENCIES. Ability to recognize and respond appropriately to VFR emergency and caution situations (e.g., lost, low fuel, partial power, power failure, etc.).

ITEM V.2.e. IFR COMMUNICATIONS. Knowledge of IFR reporting requirements, and ability to quickly compose, transmit, receive, interpret, and comply with radio messages.

ITEM V.2.f. IFR EMERGENCIES. Ability to recognize and respond appropriately to IFR emergency and caution situations (e.g., radio or electrical failure, engine failure, icing, low fuel, etc.).

ITEM V.3.a. KNOWLEDGE OF AIRCRAFT SYSTEMS AND PERFORMANCE. Knowledge of the aircraft, its systems, normal performance parameters, performance limitations, and normal and emergency operating procedures (e.g., knowledge of operation of fuel and oil systems, weight and balance, manual gear extension, etc.).

ITEM V.3.b. PREPARATION AND FILING OF FLIGHT PLANS. Ability to obtain and interpret all available information to determine the safest and most expeditious route for the mission to include weather, mission requirements and aircraft and crew capabilities; and to prepare flight logs and flight plans, file them, and obtain required clearances.

ITEM V.3.c. PREFLIGHT, STARTING, TAXI, AND RUNUP PROCEDURES. Ability to properly execute inspections and procedures in accord with the checklist, and to determine that engine(s), prop(s)/rotor(s), and other systems are operating properly or are in airworthy condition.

Flying Ability Rating Scale Used in Survey

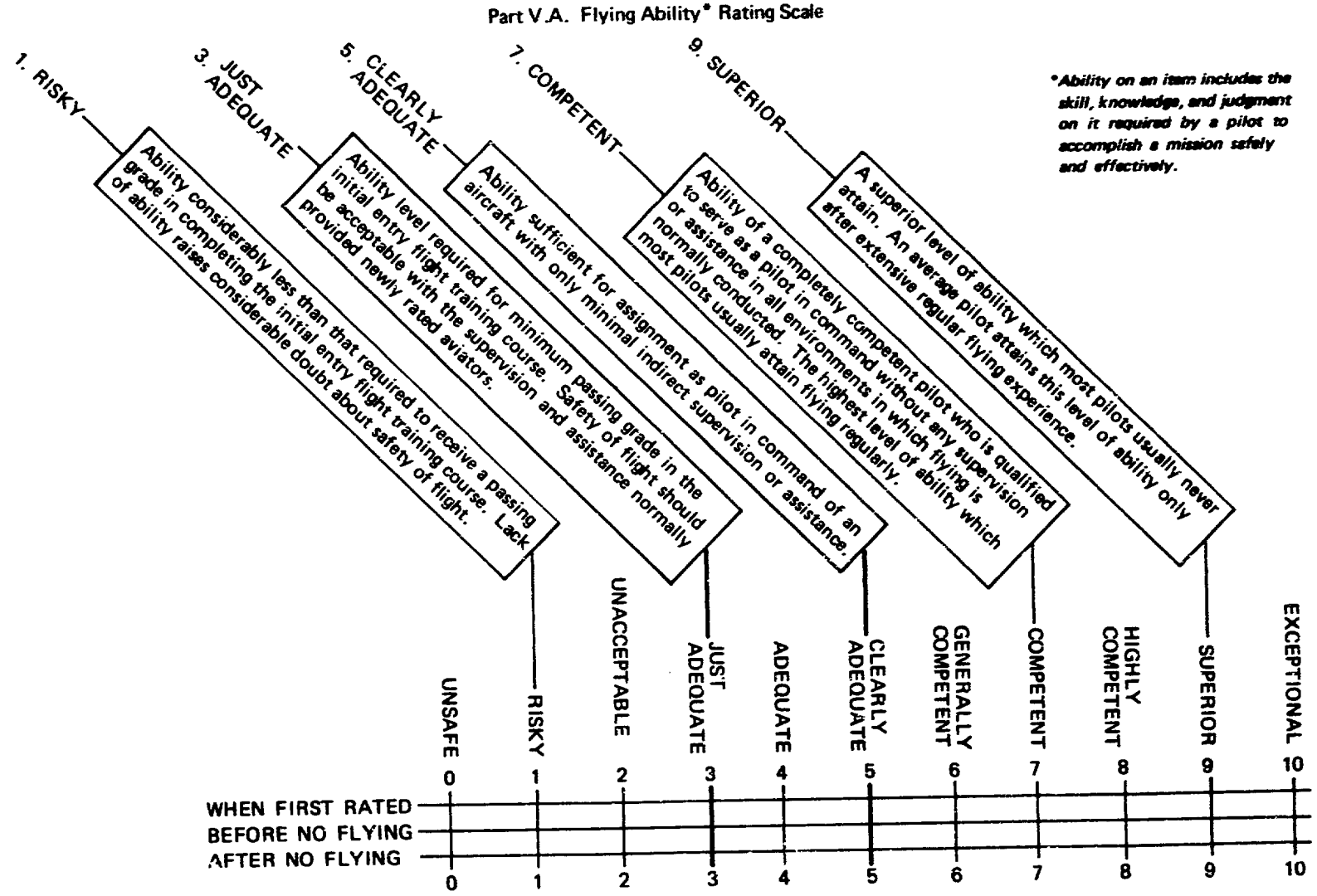


Figure 1

Overall Flying Ability When First Rated and Before Episode

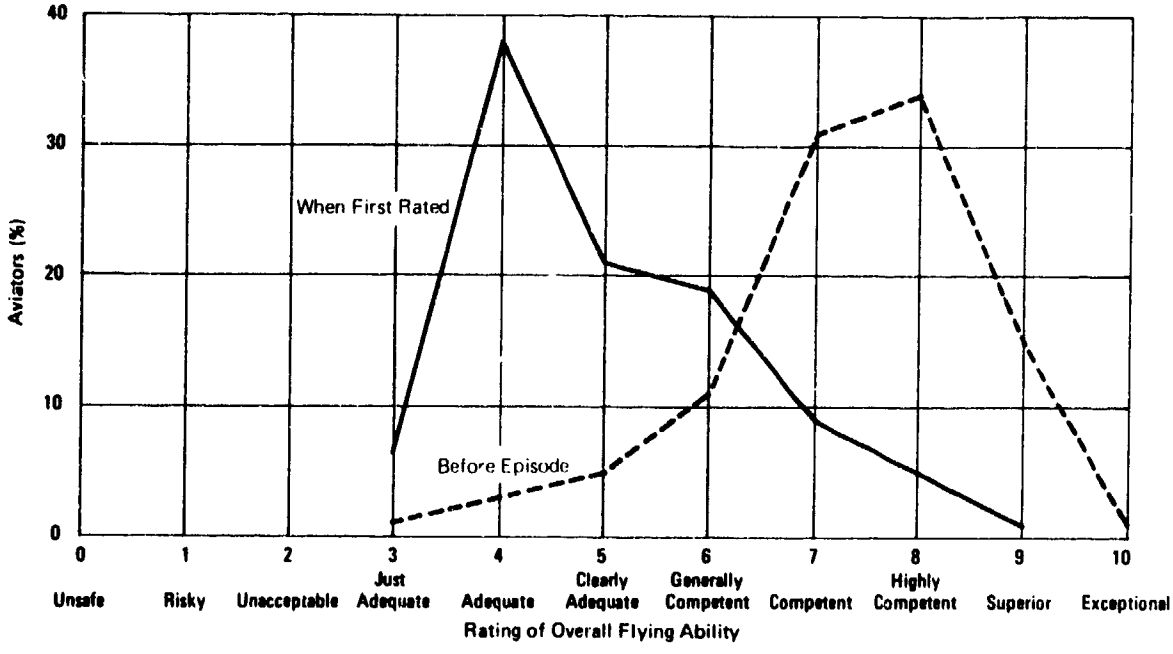


Figure 2

REFRESHER TRAINING REQUIREMENTS

In addition to the ability ratings on the 20 categories of flying skills, refresher training requirements for each of these skills were also obtained. For each category of skill, the amounts of nine different types of refresher training or refresher experience requirements were obtained, as indicated by the list of criterion measures 5 through 13:

Criterion Measures 5 to 13

(5) Actual academic or cockpit refresher training after episode.
(6) Actual refresher flight instruction after episode.
(7) Actual supervised operational flying after episode.
(8) Estimated academic or cockpit refresher training required to regain ability on skill when initially rated.
(9) Estimated refresher flight instruction required to regain ability when initially rated.
(10) Estimated supervised operational flying required to regain ability when initially rated.
(11) Estimated academic or cockpit refresher training required to regain pilot-in-command ability.
(12) Estimated refresher flight instruction required to regain pilot-in-command ability.
(13) Estimated supervised operational flying required to regain pilot-in-command ability.

Academic or Cockpit refresher training was defined as including all types of study, instruction, and cockpit time with no power applied to the aircraft. It does not include synthetic trainer time (which was obtained in a separate response category).

Flight Instruction was defined as including all engine running time, in flight or on the ground. It does not include synthetic trainer time.

Supervised Operational Flying was defined as including all flying done under supervision in support of the operational mission of the unit to which assigned.

Actual Refresher Training was defined as "the amount of refresher training/experience which was actually received on the skill." The amounts of *Academic or Cockpit* training, *Flight Instruction*, and *Supervised Operational Flying* actually received were entered in this column for each category of flying skill.

Hours to Regain Ability at Initial Rating was defined as "the amount of the three types of refresher training/experience which you estimate you would require, if any, to regain your ability at the time when you first received a pilot rating requiring the skill."

Hours to Regain Pilot-in-Command Ability was defined as "the amount of the three types of refresher training/experience which you estimate you would have required, if any, to regain the level of ability on the skill required to resume pilot-in-command flying duties."

The complexities of requesting these nine different types of refresher training were considered necessary in order to avoid various ambiguities in interpretation of the meaning of "refresher training," and in relating it to a specific level of operational flying ability.

As may be anticipated in a survey of this type without an on-site survey team to assure consistency, interpretation of the various response items varied somewhat from subject to subject. Although any such variations in subject interpretation are of concern in data analysis and data interpretation, examination of the data indicates that they should not have a significant impact on the validity of the conclusions derived from the primary analyses performed on the data obtained.

The major difficulty in interpreting survey responses concerns the distinction between "Flight Instruction" and "Supervised Operational Flying." Some respondents appeared to consider these two identical, or at least they gave identical replies to the questions on these two types of refresher training. Whether their responses should be considered one and the same, or X amount of Flight Instruction and an additional amount of X Supervised Operational Flying, could not be determined. In most cases it appears the two values are used to refer to the same block of flight hours, with "Flight Instruction" apparently contributing to the unit mission. In other cases, it appeared that the hours listed under "Flight Instruction" are included within the larger number of hours listed under "Supervised Operational Flying."

The consequence is an ambiguity concerning the total amount of refresher flight training of both "Flight Instruction" and "Supervised Operational Flying" types. It is the sum of the two types at a maximum, and at least the larger value of the two types. A value halfway between is probably a reasonable estimate for these data. No attempt was made to reconcile this ambiguity in the data analysis used. It would have required highly subjective decisions and was not regarded as a major concern, in view of the relatively small maximum values that characterize the data. However, no ambiguity exists regarding the "Flight Instruction" type of refresher training used for analysis, and this was considered to be the information of primary interest with reference to proficiency flying and CRF management, since most of the costs and time of refresher flight training should be related to this category.

In several respects the number of refresher training hours indicated and used for analysis, in particular the "Actual" hours, is on the high side for some individuals. One reason is due to refresher training in several aircraft, which is common for experienced

aviators upon assignment to a unit operating several types of aircraft. The time in each type of aircraft was obtained, and on a percentage basis this multiaircraft refresher training was found with about equal frequency in the *No Fly* and *Minimums Only* groups.

In these cases, the total hours of refresher training received in all types of aircraft was used for data analysis and all of these hours were assigned to the type of aircraft in which the majority of refresher training was received. The hours of refresher training in a single aircraft was not selected as the basis for data analysis in these cases, since arbitrary decisions were required and internal inconsistencies in the data would have been introduced.

Chapter 2

SYNOPSIS OF RESULTS

The primary results of this study consist of dozens of comparisons and hundreds of data points, which can be examined to answer the main questions of concern and numerous additional questions that were not posed.

In any presentation of such a voluminous amount of data, it is easy to lose sight of the more significant results obtained. Therefore, a synopsis will be used to present what are considered to be the major results of the study. This synopsis will be based on standard instrument rated aviators, since current planning anticipates that all Army aviators will be standard rated in the future.

The results presented in this section will consist mainly of combinations of several separate analyses and smoothed best-fit curves to the data, in order to illustrate the results more clearly than would be possible with the separate raw data curves. In all of the curves the values between zero and six months episode duration are simple extrapolations of the existing data, on the basis of the assumption that loss of flying ability and refresher training required will be zero for an episode of zero duration, and therefore, the describing curves must pass through zero loss or zero refresher training at zero months episode duration.

Linear, exponential, and power curve fitting routines[1] were used to determine which type of function resulted in the best fit for the data. (Empirical values of zero were changed to .1 for the exponential and power functions because these functions do not allow for zero values.) The power curve was found to provide a better fit than the linear or exponential curve. The least squares were used to compute the best fitting power curve equation for each set of data; these equations were used in plotting the curves shown in this report.

EFFECTS OF MINIMUMS ON LOSS OF FLYING ABILITY

The curves of mean ability in Figure 3 illustrate loss of ability on VFR and IFR flying skills reported by standard instrument rated pilots, as a function of length of the nonflying or minimums episodes. The loss function of standard instrument rated pilots is comparable for both VFR and IFR skills, whether or not minimums are flown. The *rate* of loss and *amount* of loss are very comparable in all four curves, although the actual levels of ability between VFR and IFR differed substantially. Flying minimums was found to slightly reduce the estimated rate of loss and amount of loss, with the effect more pronounced for VFR flying skill than it is for IFR skill. Drop in ability on the 10-unit rating scale used was about 3 units for pilots who did not fly, and about 2.5 units on VFR skills and 2.8 units on IFR skills for pilots who flew minimums. Thus, pilots who flew minimums reported losing about 80% as much on VFR ability, and about 90% as much on IFR ability, as pilots who did not fly at all.

[1] These routines are available with the Hewlett Packard 9810 calculator. Use of proprietary names in this report is for purposes of research documentation and does not imply endorsement by the Department of the Army or HumRRO.

Effect of Length of Nonflying or Minimums Episode on Retention of Flying Ability by Standard Instrument Rated Aviators

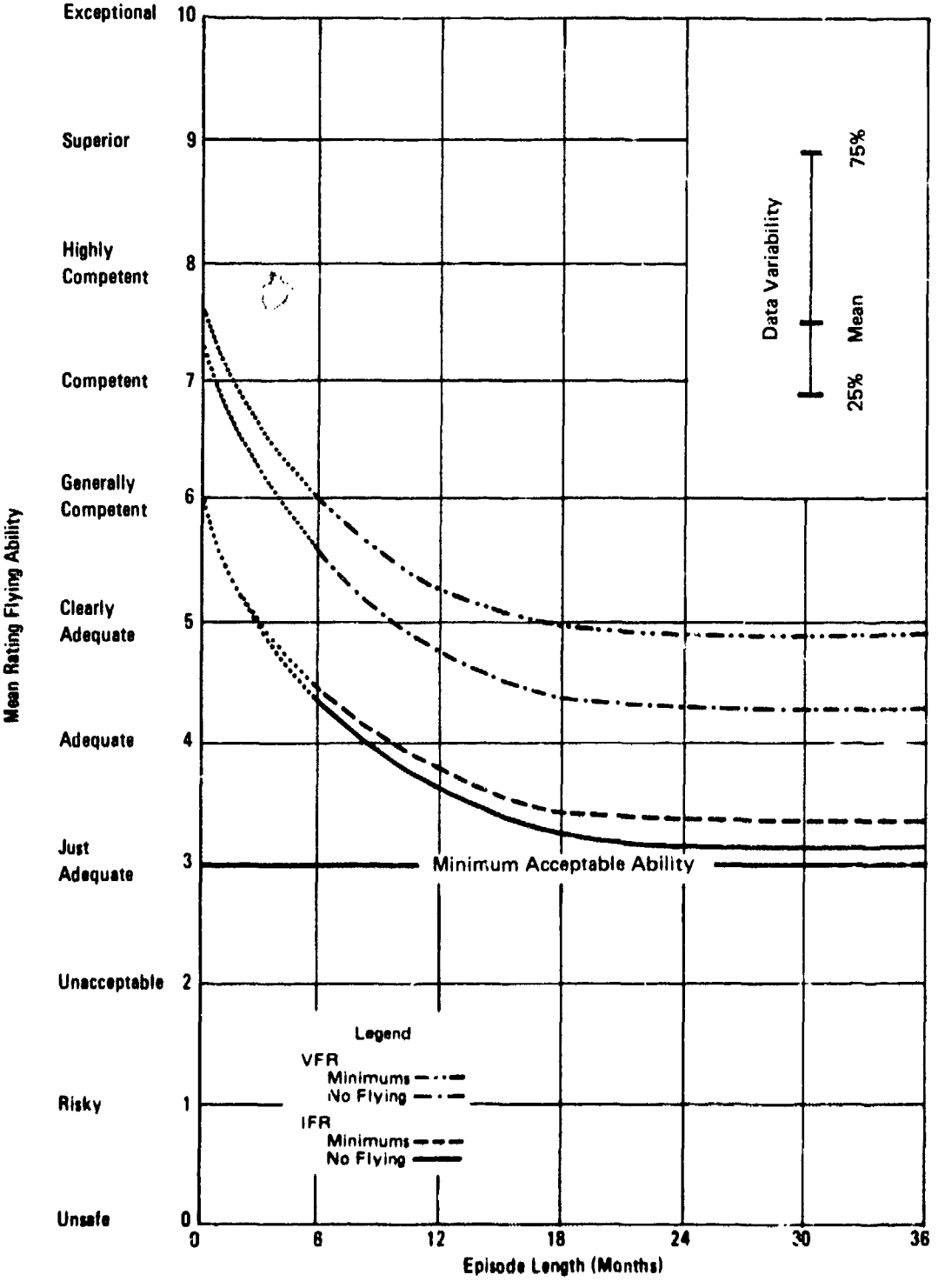


Figure 3

Considering variability in responses (shown for 25th and 75th percentile pilots), VFR flying skills remained above the minimum acceptable level of ability through three years for almost all pilots whether they flew minimums or not, while for IFR skill some standard instrument-rated pilots dropped below a minimum acceptable ability level (3.0) by six months, and about one-half of them dropped below this level by 12 months. These percentages of pilots below the minimum acceptable level of ability on IFR flying skill were not significantly affected by whether minimums were flown or not.

The difference in asymptotic level of ability for VFR and IFR skills is the same as the difference between these skills at the start of the episode. However, there is no basis for concluding that these asymptotic differences are *due* to the initial differences. This is a potential explanation; however, it is also possible these same asymptotic differences would be found if initial IFR ability were the same as initial VFR ability. Initial IFR ability comparable to that for VFR ability might be lost more rapidly all the way down to the asymptotic IFR level of ability observed, or the rate and amount of loss in ability could stay the same, with a resultant asymptotic level of ability comparable to that found for VFR flying skill. A true situation somewhere between these two extremes is possible if initial IFR ability were increased to equal that for VFR. However, an asymptotic level of IFR ability close to that observed here for IFR skill is regarded as most probable.

It should be noted that ability on IFR skills of pilots who did not have a standard instrument rating was reported as being considerably lower at the beginning of the episode than for pilots with a standard rating (4.6 versus 6.1), and dropped at a slower rate to below the minimum acceptable ability level of 3.0 in less than a year.

When standard instrument rated pilots are considered, therefore, no difference appears to exist between VFR and IFR flying skills in terms of the estimated rate of loss or amount of loss in flying ability. However, due to the lower initial level of ability on IFR skill, the average level of IFR ability after the episode is at, or just above, the minimum acceptable ability level (3.0). This indicates that about one-half of the standard instrument rated pilots will be below a minimum acceptable level of ability after an episode of one year or more, whether or not they engage in proficiency flying as it has been conducted in the past.

For practically all standard instrument rated pilots to maintain IFR flying ability above the minimum acceptable level, it would seem that refresher training is required at about six-month intervals. VFR refresher training, however, would not be necessary for intervals up through three years, in order to maintain ability above the minimum acceptable level for performing operational flying duties. These data would seem to indicate that it would be most profitable to devote all proficiency flying (or the great majority of it) to instrument flying. It is probable that some part of this instrument training would transfer to VFR flying, with consequent high confidence that VFR flying skill would hold up above the minimum acceptable level of ability.

EFFECTS OF MINIMUMS ON REFRESHER TRAINING REQUIREMENTS

Figure 4 shows, as a function of length of episode of nonflying or flying minimums, the average refresher flight instruction received by standard instrument rated pilots before initial resumption (generally supervised) of operational flying duties, and for resumption of unsupervised operational flying duties as pilot in command of an aircraft. The reports indicated that proficiency flying, in comparison to not flying at all for an equal period of time, reduced refresher flight instruction by about 23% (8.5 to 6.5 hours) of the instruction required to begin performing flying duties, and by about 37% (19 to 12 hours) of the estimated instruction required to perform as pilot in command.

Effect of Length of Nonflying or Minimums Episode on Refresher Flight Instruction Required to Begin Performing Flying Duties and to Perform as Pilot in Command

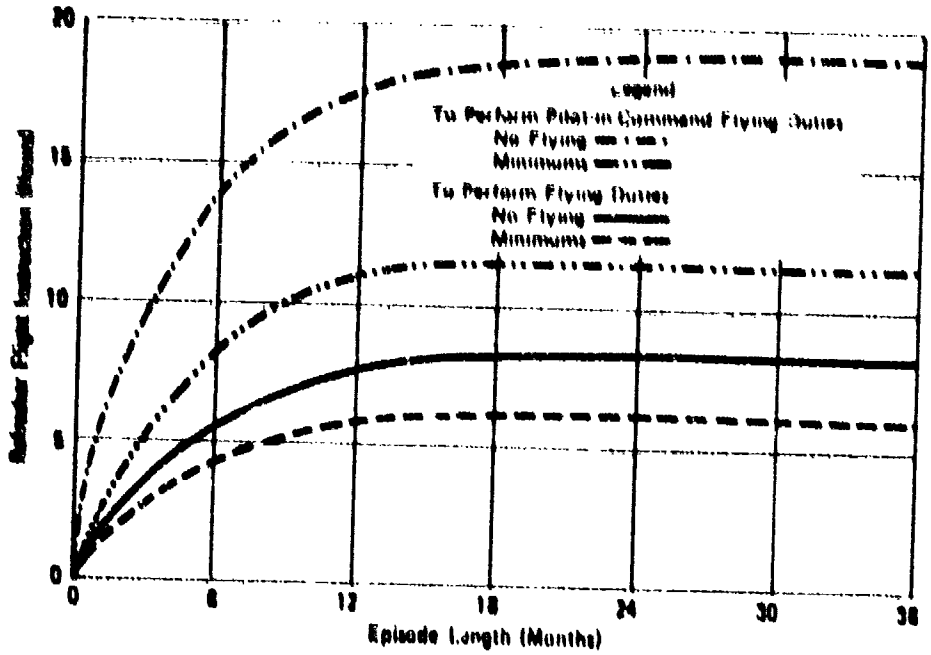


Figure 4

However, these savings of 2 to 7 hours in refresher flight instruction represent only a small fraction of the hours of proficiency flying that would be required over a 6- to 36-month period of nonflying duty. Since there are relatively few hours of refresher flight instruction required without any flying (8.5 to 19.5 on the average), and nearly as much time is needed if minimums are flown, it could be concluded that proficiency flying as it has been performed in the past is economically impractical. The ability retention and refresher training data together clearly indicate that a policy of flying excusal, followed by refresher training before resumption of operational flying duties, should provide units with considerably more proficient aviators at considerably less cost. Even if considerable improvement in the effectiveness of proficiency training should be obtained, the small average amounts of refresher training required after flying excusal indicate that excusal plus refresher training should be more economical, unless the costs of proficiency training could be reduced significantly.

Chapter 3

DETAILED RESULTS

The detailed results[1] will be presented primarily in the form of answers to the scope factors and questions posed in the request for the study, and additional factors assessed due to various research considerations. Unless otherwise indicated, the refresher training measure used for comparisons is the maximum value reported by each pilot for any of the four overall flying skill categories (Skills V, V1, V2, and V3). Numerous other measures could be considered, but using all 13 measures obtained could be confusing to the reader and this composite was regarded as the best single measure. Unless a more restricted sample is indicated, the sample basis of the comparison is all pilots meeting sampling acceptance criteria. About half of these pilots had a standard instrument rating and half did not.

SURVEY RETURNS

Of 5,500 survey forms sent out in the "shotgun" sampling approach, 525 were completed and returned. Of these 525 returns, a total of 175 were used in at least part of the data analysis: 117 in the *Minimums Only* category and 58 in the *No Flying* category. Complete returns for all items were obtained for 95 *Minimums Only* and 41 *No Flying* pilots. One hundred and twenty-four of the returns not used fell in the backup *No Instruments* category that was not analyzed, and the remaining 226 did not meet one or more of the criteria for inclusion in the analysis--primarily noncompletion of the episode or the refresher training after it.

The number of usable returns, while less than desired, was generally sufficient to answer the primary questions of concern in the study with reasonable statistical confidence.

ANALYSIS OF DATA

The number of potential analyses is so extensive for the large number of combinations of factors on which data were obtained in this survey that complete analysis will not be attempted. To fully review the factors considered for all 260 skill/criterion measures would also be prohibitive. Consequently, only a few single or composite criterion measures were used to answer most questions considered. Although these were selected as most appropriate for the concerns in this study, many readers may be interested in a different criterion or factor. Data are furnished in the appendices, therefore, to provide information on additional criterion measures and to permit assessment of the effect of factors not evaluated in this study.

[1] In this section and in Appendix B the ratings of flying ability are reported on a scale of 0 to 100, obtained by multiplying original values by a factor of ten (in order to facilitate data analysis).

In Appendix B a comparison is provided of *Nonflying* with *Minimums* groups for all 13 criterion measures on all 20 skill categories. The following statistics are provided for each group in tabular form:

(1) Mean
(2) Standard deviation
(3) Number of subjects composing the group-N
(4) Minimum value
(5) 5th percentile value
(6) 10th percentile value
(7) 25th percentile value
(8) 50th percentile value
(9) 75th percentile value
(10) 90th percentile value
(11) 95th percentile value
(12) Maximum value

The percentile distributions were included, since they were regarded as highly pertinent information for policy planners. The mean provides a single measure that facilitates comparisons, but the standard deviation and percentile distributions provide information on expected variability in the pilot population that should also be considered in proficiency/CRF policy planning.

SCOPE FACTORS

(1) *Fixed-Wing Versus Rotary-Wing Aviators*

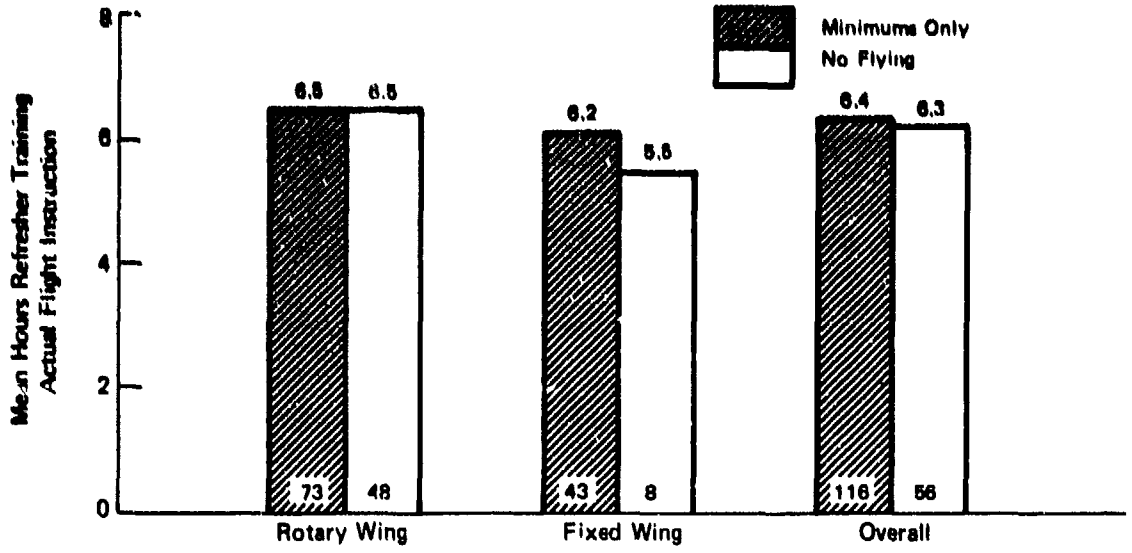
No significant differences were found in terms of actual refresher flight instruction pilots reported receiving after the episode (see Figure 5). The direction of the differences was for fixed-wing refresher training to require slightly less time than rotary-wing refresher, although these differences did not approach significance. A number of other comparisons between fixed-wing and rotary-wing also did not result in any differences that approached significance.

(2) *Length of Episode*

No differences in flying ability (see Figure 3) or in hours of refresher training (see Figures 4 and 6) were found between periods of minimums or nonflying of 12 months or more. The large variability in refresher flight instruction for the six nonflying pilots (seen in Figure 6) with episodes 19 months or more (values of 15, 5, 0, 20, 4, and 20) precludes considering the three-hour average increase over the 9-12 and 13-18 month groups as significant. However, at 6-8 month episode length, both the loss of ability and hours of refresher training required are significantly ($p<.05$) less than for the longer episodes.

It can be seen more clearly in Figure 3 that the lack of differences between episodes 12 to 36 months in length is due to the fact that almost all of the loss in ability that is going to occur has already taken place by 12 months. The refresher training data generally reflect this situation. The significant reduction in refresher training requirements for pilots who flew minimums for 19 months or more does not have any evident explanation based on the data obtained, although several hypotheses can be suggested.

No Flying Versus Flying Minimums Only



NOTE: Figure at bottom of bar shows number of pilots in group.

Figure 5

Effect of Length of Episode on Flight Instruction Received

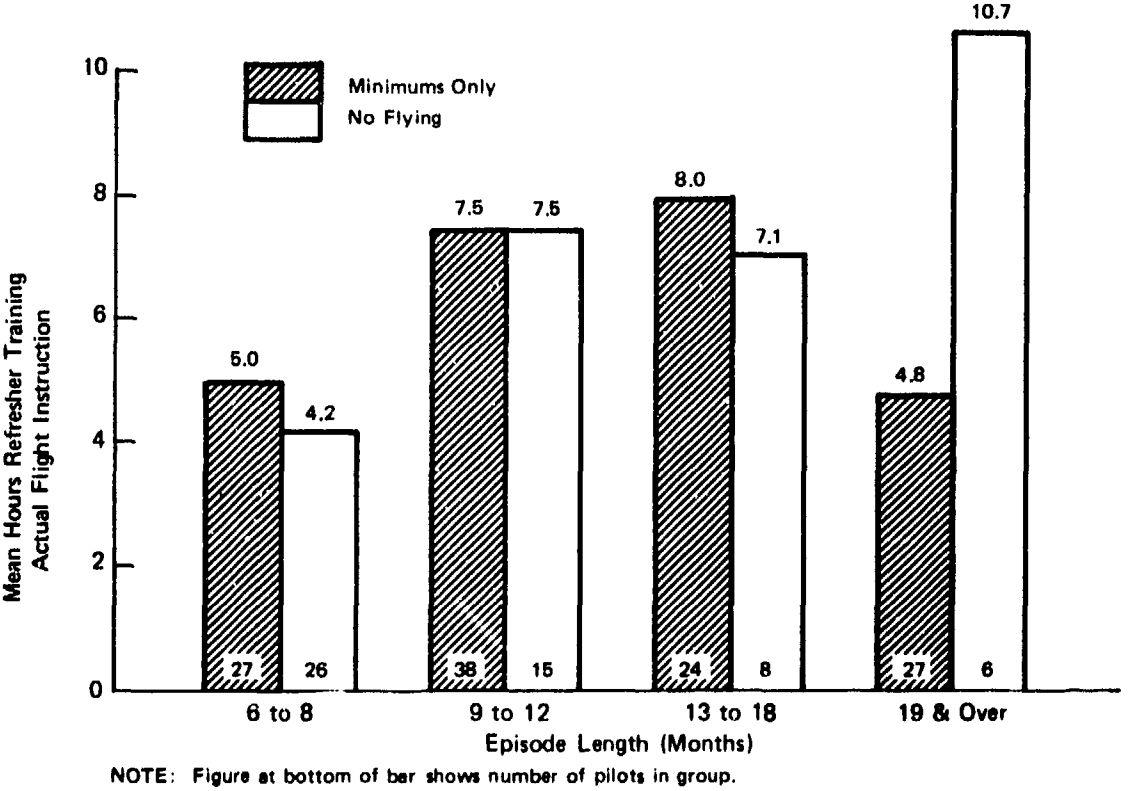


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Figure 6

(3) *Aviator Rated Flying Experience*

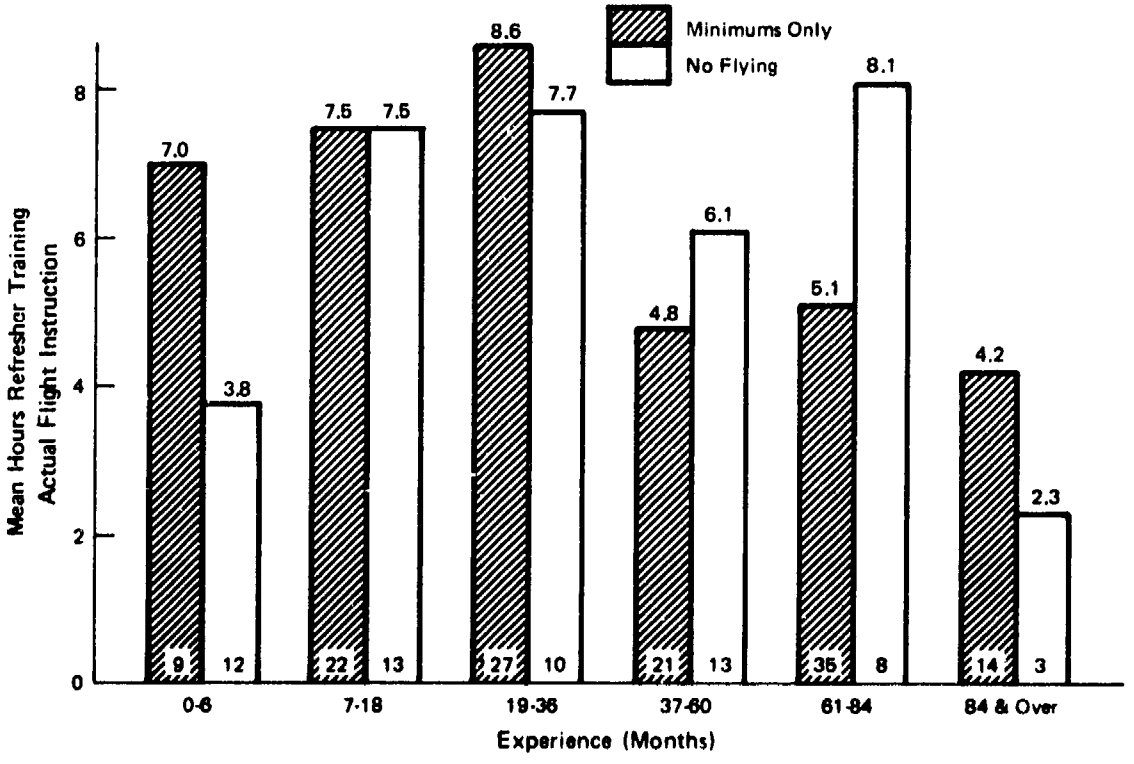
Flying experience did not have an extremely large effect (see Figures 7, 8, and 9). After three years of experience there was a general trend toward less refresher training with increased experience (Figure 7). Hours of experience in the model of aircraft used for refresher training had no consistent effect (Figure 8). Total flying hours (Figure 9) indicated a trend of reduced refresher training above 1,000 hours for pilots who did not fly minimums, and above 2,000 hours for pilots who did.

Inexperienced pilots (0-500 hours) who did not fly required less refresher training than more experienced pilots, and for pilots who flew minimums there was a trend of increasing refresher training until the 1000-2000 hours' experience level was reached. All three measures of flying experience showed an anomalous reduction of refresher training requirements for very inexperienced pilots. This may be attributed to the fact that these pilots were closely supervised and given little responsibility until they had gained more experience.

(4) *Proficiency Level for Operational Flying Duty*

The study request defined the required proficiency level for operational flying duty as that level required for graduation from the USAAVNS (either fixed-wing or rotary-wing) initial entry flight training course. Although this definition was the key

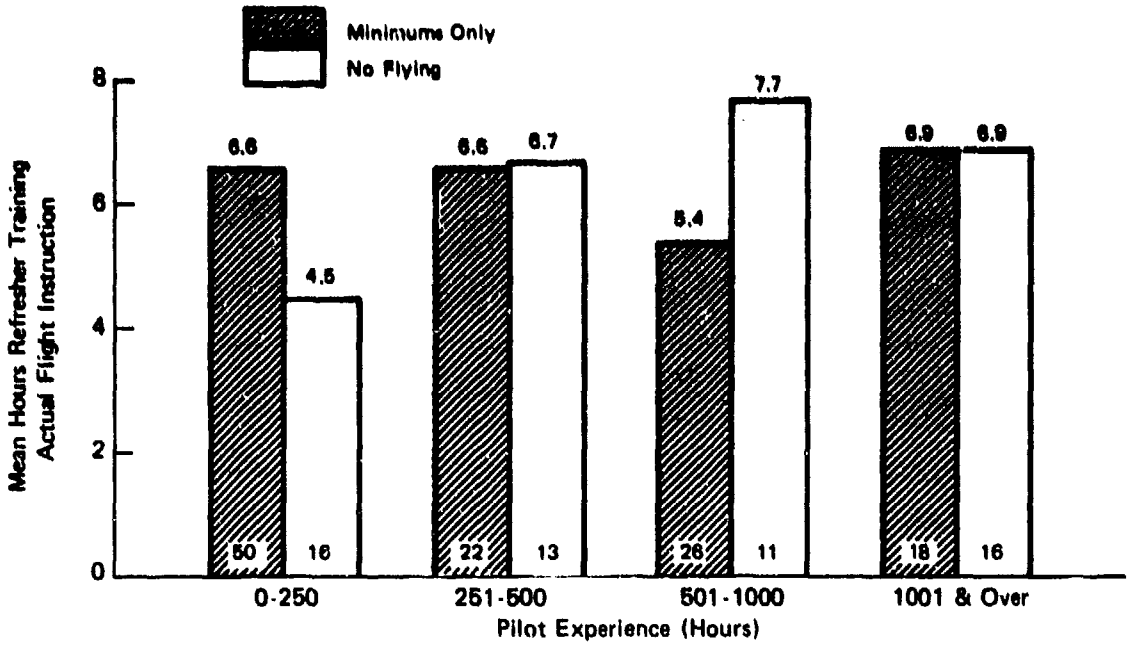
Effect of Months Rated Before Episode on Flight Instruction Received



NOTE: Figure at bottom of bar shows number of pilots in group.

Figure 7

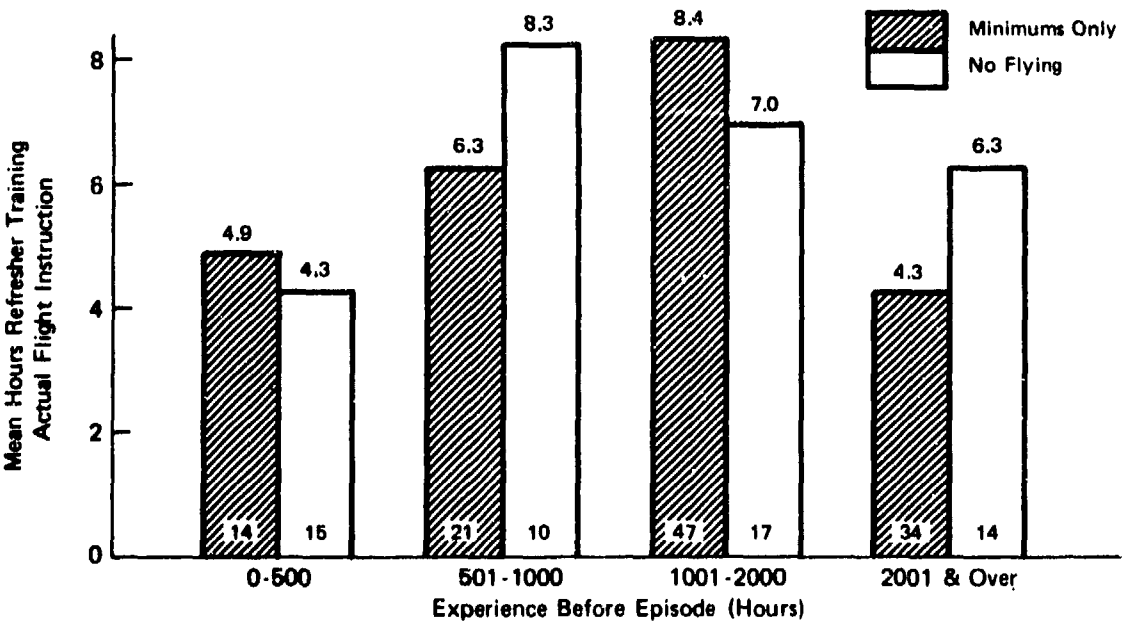
Effect of Hours in Model Used for Refresher Training on Flight Instruction Received



NOTE: Figure at bottom of bar shows number of pilots in group.

Figure 8

Effect of Hours Flown Before Episode on Flight Instruction Received



NOTE: Figure at bottom of bar show number of pilots in group.

Figure 9

rating anchor in the flying ability rating scale used, for recall of refresher training requirements the criteria were keyed against the pilot's own experience rather than this more abstract criterion. The criterion closest to it was "Initial: Ability when initially rated as a pilot." This criterion should average to the average ability of the graduates of initial entry classes rather than just under the lowest passing graduate of the class. The two other criteria were "Actual: Training actually received before resuming operational flying duties," and "Pilot in Command: Training required to resume pilot-in-command flying duties."

Table 2 shows the comparison of refresher training requirements for these three criteria of proficiency. It was found that the estimated requirement for refresher training to regain initial rating proficiency was slightly more than that actually received, about one-half that required to regain pilot-in-command ability for pilots who flew minimums, and about one-third for pilots who did not fly. It may be inferred that refresher training to regain that minimum ability required to graduate from an initial entry course should be less than that for initial rating ability, since all graduates when initially rated had to equal (and most were above) that minimum ability.

Therefore, the "Initial" refresher training requirements reported here and in the skill-by-skill summary table in Appendix B may be regarded as values that will exceed those needed to meet the defined minimum proficiency level required for operational flying duty. Although it is likely these "Initial" values will exceed those required to achieve "minimum acceptable graduation ability" by 100% or more, the slightly lower "Actual" refresher training values are suggested as a conservative estimate of this minimum acceptable ability.

Table 2

Refresher Training Required to Meet Three Proficiency Criteria

Proficiency Criteria	Pilots Who Flew Minimums *(Hours)*	Pilots Who Did No Flying *(Hours)*
Actually Received	6.4	6.3
Initial Rating Ability	7.3	6.8
Pilot in Command Ability	14.7	19.6

ANSWERS TO SPECIFIC QUESTIONS

(1) *What type of aviation skills most rapidly deteriorated during periods of nonflying?*

IFR flying skills were reported as dropping to significantly lower average levels of ability than VFR skills or knowledge and procedural skills (see Figure 3 and Table 3). However, since the average level of IFR ability at the start of the episode was also correspondingly lower, it is not possible to directly conclude that IFR flying skill deteriorates more rapidly. Nevertheless, on the basis of the data for aviators who lack the standard instrument rating, it is concluded that, if IFR ability were improved to a level comparable to that for VFR ability, it would deteriorate more rapidly down to an asymptotic level equal or close to the level found in this study.

Table 3 provides, for pilots who flew minimums and those who did not, their ratings of their average ability before and after the episode on the 20 types of skills examined. Skills numbered 0, 1, 2, and 3 are overall skill categories as labeled in Table 1, and those numbered 1a through 3c are subcategories as labeled in Table 1.

The only average ability ratings that come close to falling below the minimum acceptable ability level of 3.0 were IFR skills after the episode. It should be noted that overall IFR skill is rated lower than any of its individual component skills, a situation not found with VFR or Knowledge/Procedural skills. It may be concluded that an overall integrating aspect of IFR skill exists that is either not present or much less pronounced for VFR and Knowledge/Procedural skills.

Table 3

Ratings of Flying Abilities Before and After Episode[a]

Skill Area	Minimums		No Flying	
	Before	After	Before	After
0. Overall Flying Ability	73.0	47.3	70.6	43.3
1. Overall VFR Flying Ability	75.0	50.3	73.2	46.6
1a. VFR Basic Maneuvers	73.7	51.5	73.0	49.8
1b. VFR Cross-Country–Day and Night	75.1	56.2	73.6	56.3
1c. VFR Advanced Maneuvers/Operations	73.2	47.5	71.5	47.1
1d. VFR Power Limited Operations	74.4	48.3	69.5	46.4
1e. VFR Low Level Flight and Navigation	73.2	52.1	71.5	50.0
1f. VFR Emergencies	73.1	51.7	70.7	48.2
1g. Army and Civil Regulations for VFR Operations	69.0	52.2	64.5	45.0
2. Overall IFR Flying Ability	56.9	34.8	49.2	30.2
2a. IFR Basic Maneuvers	61.4	40.4	55.7	37.9
2b. Army and Civil Regulations for IFR Operations	60.5	41.6	51.0	35.3
2c. IFR Terminal Approaches and Departures	60.2	40.6	51.2	34.5
2d. IFR Cross-Country–Day and Night	62.4	45.1	54.1	37.1
2e. IFR Communications	60.8	42.1	50.2	36.5
2f. IFR Emergencies	59.8	43.0	50.1	35.9
3. Knowledge of the Aircraft and Preflight Procedure	73.7	52.0	71.6	50.1
3a. Knowledge of Aircraft Systems and Performance	72.3	53.9	70.9	50.4
3b. Preparation and Filing of Flight Plans	70.7	54.7	66.3	50.3
3c. Preflight, Starting, Taxi and Run up Procedures	74.5	57.5	71.9	56.5

[a]A value of 30 corresponds with the flying ability required for a minimum passing grade in the initial entry flight training course, and is considered the minimum ability acceptable for performance of operational flying duties. A value of 50 corresponds with ability sufficient for assignment as a pilot in command, and a value of 70 corresponds with the ability of a completely competent pilot.

(2) *What is the extent of this deterioration?*

Figure 3 presented a summary interpretation of the average extent of deterioration estimated for VFR and IFR flying skill as a function of length of episode for

standard instrument rated pilots. Table 3 summarized the extent of this deterioration for each type of skill. The extent of deterioration may be inferred by comparison of the rating category labels corresponding to the before and after rating values. Figures 10, 11, 12, and 13 summarize by percentile distributions the rated loss of flying ability with reference to the minimum acceptable level of 30.

It may be seen that, except for IFR ability (Figure 12), only a small percentage of the pilots who did not fly minimums dropped below this minimum acceptable level after the episode. For overall IFR ability, however, it is found that about one-half of the pilots were rated below this minimum acceptable level after the episode and some even before the start of the episode. Separate evaluation of standard instrument-rated pilots indicated their IFR ability after the episode was similar to that for the whole sample shown in Figure 12, although their ability before the episode was higher.

Loss of Overall Flying Ability During Episode

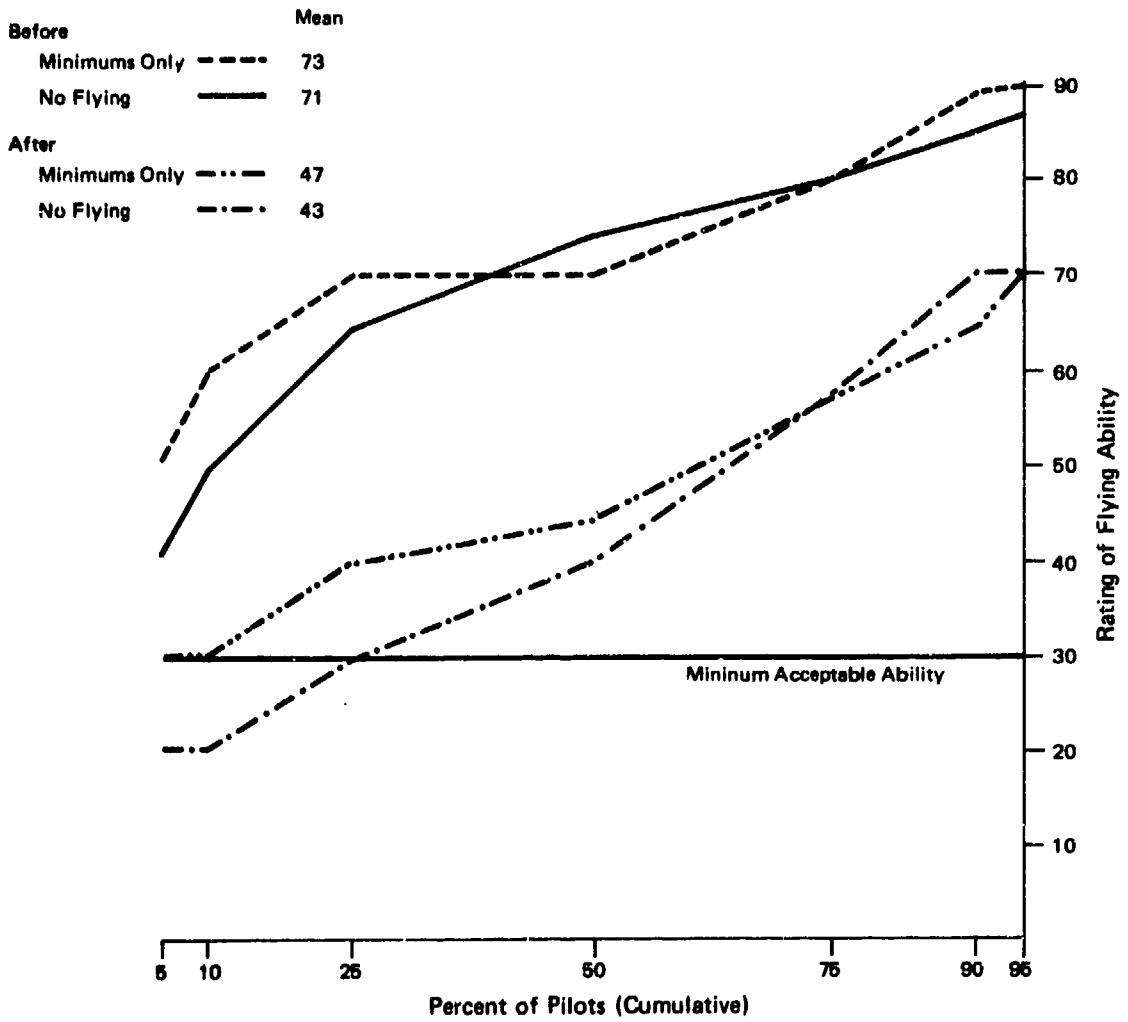


Figure 10

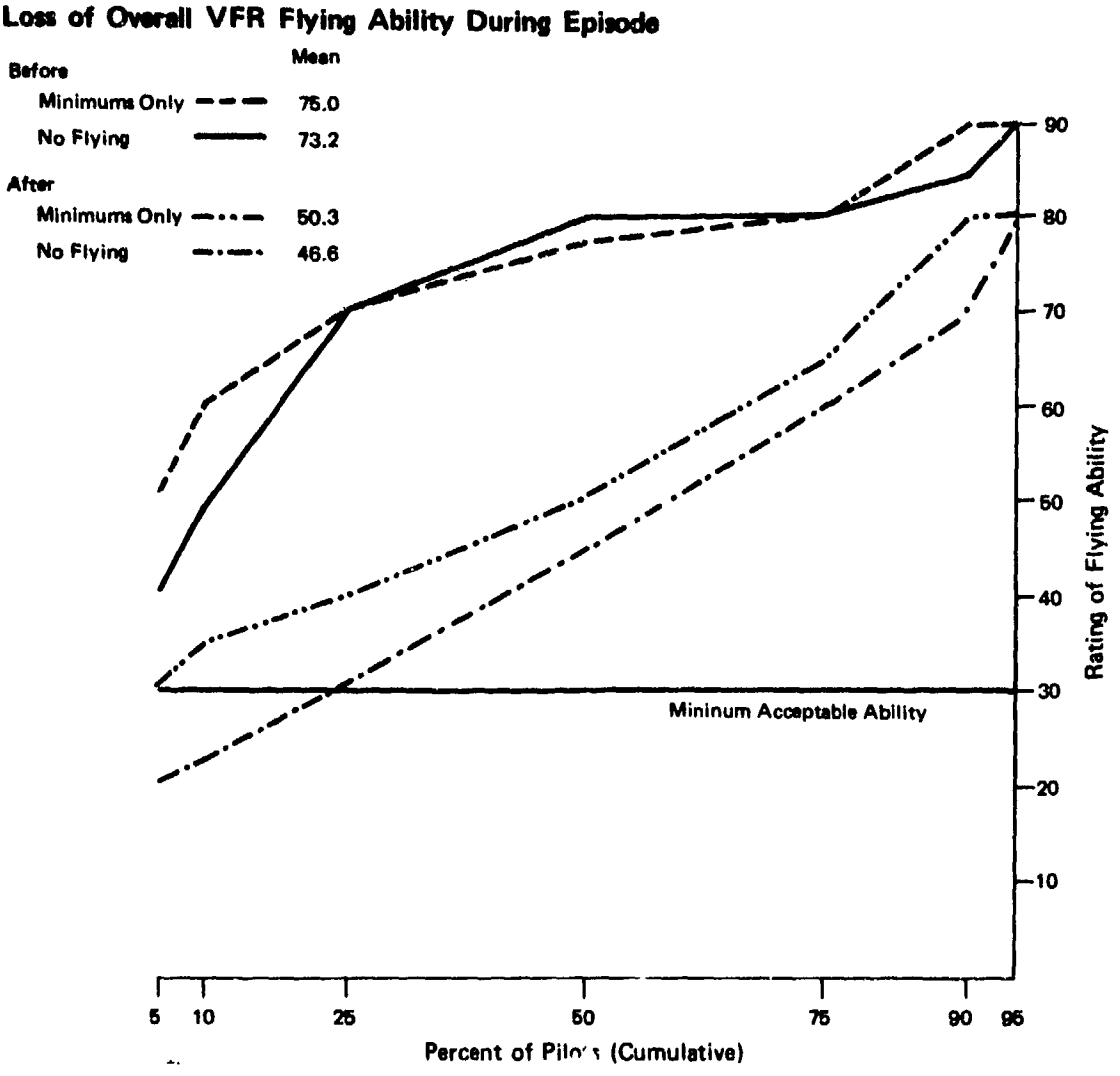


Figure 11

(3) *What are the requirements for refresher training to re-establish the aviators' original proficiency level following the various nonflying periods?*

The refresher training requirements by type of skill, type of training, and refresher criterion, are tabulated in Appendix B as means and percentile distributions. Table 2 summarizes the overall refresher training requirement, which averages 6 1/3 hours for resumption of flight duties, and 15 to 20 hours prior to resumption of the duties of pilot in command.

Figure 4 shows for standard instrument rated pilots the average refresher flight instruction actually received and that required to regain pilot-in-command flying ability, as a function of the length of episode, and Figure 14 shows the same function for the entire sample for the flight instruction actually received. It may be seen that no significant differences due to length of episode exist after 12 months in regard to

refresher training requirements. Figure 5 supports this same conclusion in bar-graph format.

(4) *Will periodic flying during the nonflying tour of duty materially affect the aviators' proficiency and reduce refresher training requirements?*

The comparisons of flying minimums with not flying in Figures 3-5, Figures 10-19, Tables 2 and 3, and Appendix B all provide a portion of the answer to this question for various types of flying skills and refresher training. The general conclusions drawn are:

(1) In comparison to not flying at all, flying minimums, as they have typically been flown in the past, reduces the loss in ability by 20% (VFR skill) or 10% (IFR skill).

Loss of Overall IFR Flying Ability During Episode

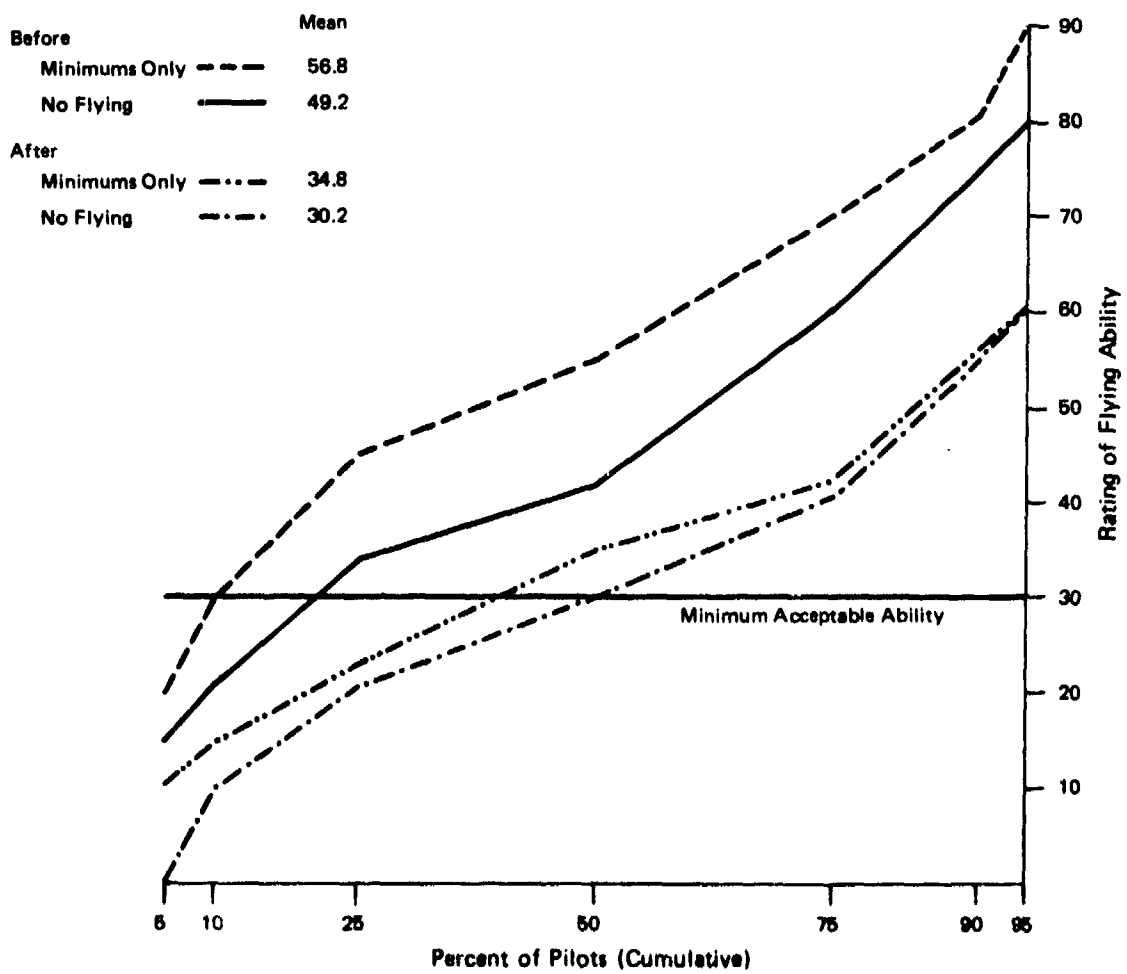


Figure 12

Loss of Knowledge of the Aircraft and Preflight Procedures During Episode

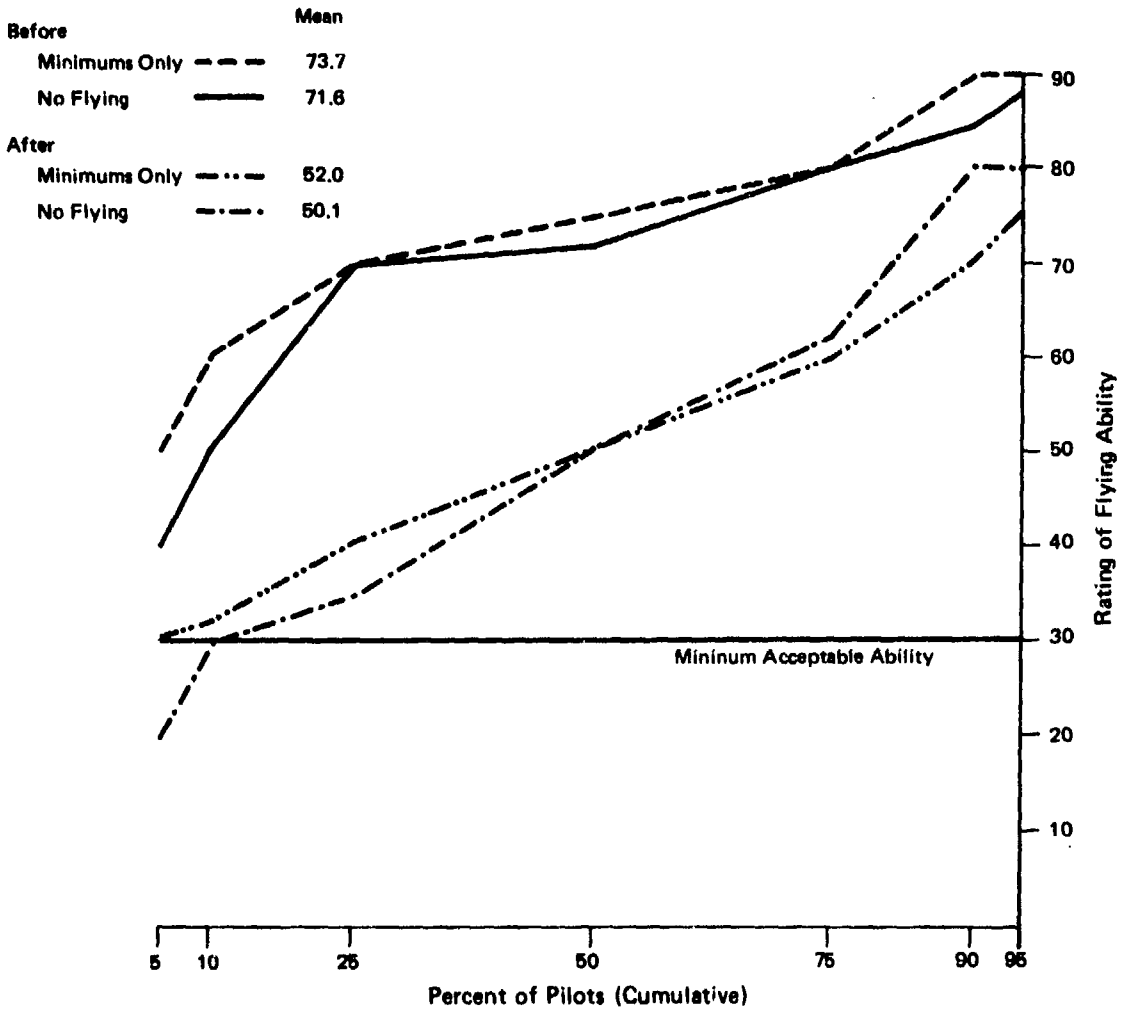


Figure 13

(2) Flying minimums has a small (two-hour) effect on the refresher flight instruction needed to resume operational flying duties under some supervision.

(3) Flying minimums significantly reduces (by 5 hours) the refresher flight instruction needed to resume pilot-in-command operational flying duties from an average of 20 hours to 15 hours.

(5) *If periodic flying is recommended, at what intervals and how much flying should be accomplished?*

From a cost standpoint alone, periodic flying would not seem to be a desirable schedule. Rather, nonflying followed by refresher training at the end of the episode would provide units with the most proficient aviators at least cost. The data in

Effect of Length of Episode on Actual Flight Instruction

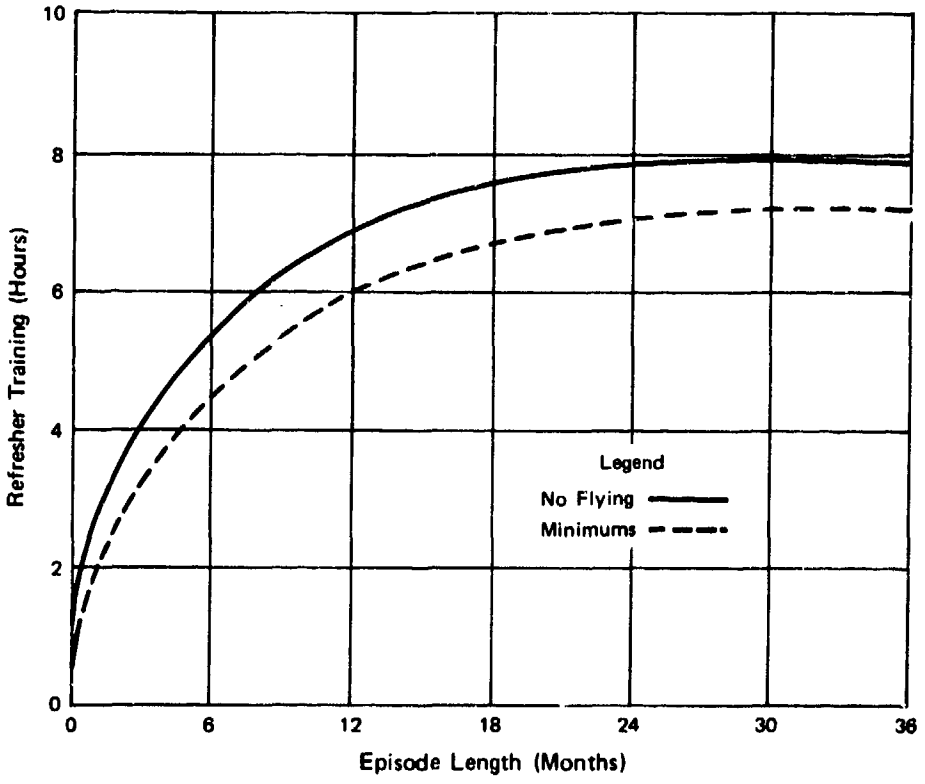


Figure 14

Appendix B indicate 60 to 80% of this refresher training should be on IFR flying, all of which could be in a synthetic trainer if high fidelity exists with the duty aircraft cockpit control and display layout.

It is estimated that the total refresher flight instruction should be established initially at 10 hours if initial flying duties are to be as a copilot, and at 20 hours if initial duties are to be as pilot in command. If a proficiency-based rather than hours-based program could be established so that average data would apply, average refresher flight training should be six hours for copilot duties and 16 hours for pilot-in-command duties. It is possible that these hours could be reduced by 20 to 50% as experience is obtained and a synthetic-oriented refresher training program optimized.

A proficiency training concept involving very low cost synthetic IFR training is the only periodic proficiency training concept that could be supported on a cost basis, but no equipment or data pertinent to the concept currently exist within the Army.

(6) *Does flying relatively simple, light aircraft contribute to proficiency in sophisticated complex aircraft?*

The data obtained would generally indicate that it does not, or that the benefit is quite small. As indicated in Figure 20, insufficient data were available to answer the question directly for pilots who did not fly and got their refresher training in complex aircraft. When light and standard (utility) aircraft were used for refresher training, the

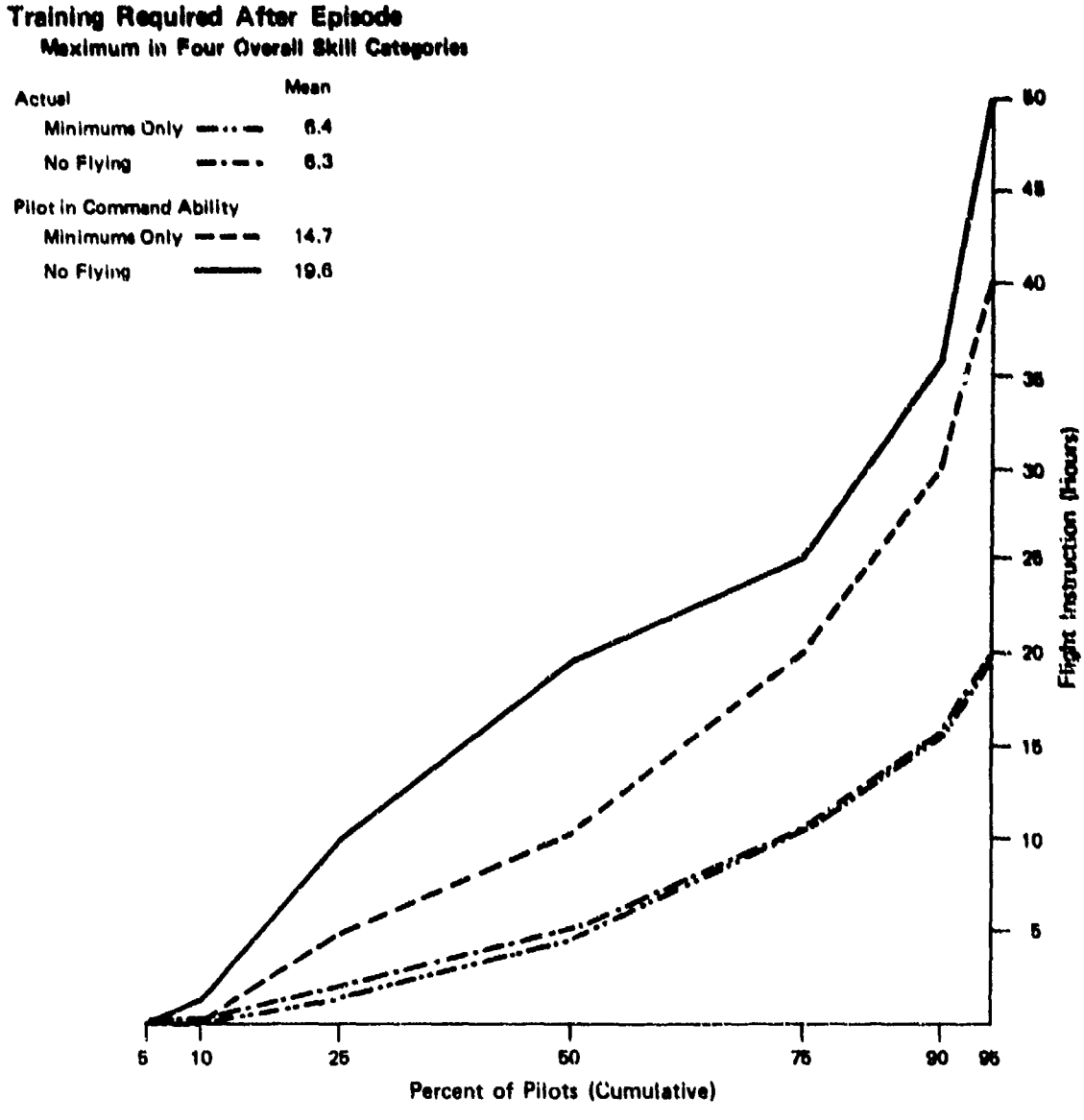


Figure 15

direction of the difference was toward pilots who do not fly needing *less* refresher training than those who flew minimums. This is suggestive of an *increase* in refresher training requirements due to flying minimums. The lack of the anticipated increase in refresher training with increase in aircraft complexity appears to be due to the fact that pilots of complex aircraft usually manage to get at least one-fifth of their minimums in the complex aircraft used for refresher training. The increase in refresher training for nonflying pilots from light to standard utility aircraft (from 4.0 to 6.8 hours) is significant ($p<.05$), however.

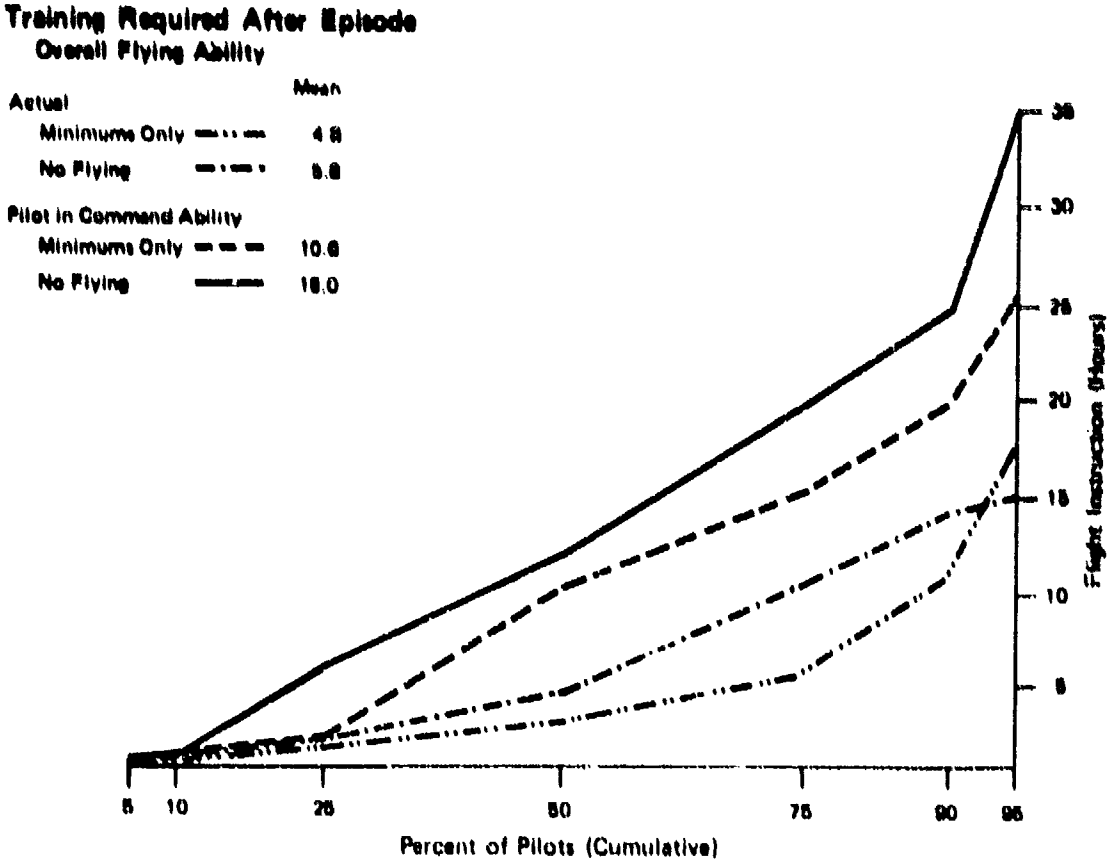


Figure 16

In Figure 21, flying minimums in light aircraft is found to increase refresher training required by 1.1 hours when refresher is in light aircraft, and by 1.2 hours when refresher is in utility aircraft. This negative transfer effect of flying minimums in light aircraft in comparison to not flying at all, is probably due to a general negative transfer effect that would be expected between different types of aircraft, and not directly related to the fact of using a light aircraft for minimums. At least the negative transfer from light to light aircraft would support this interpretation.

(7) *What is the comparison of refresher training requirements for nonflying, periodic flying of light proficiency aircraft, and periodic flying of operational aircraft?*

As covered in the item above, refresher training in light aircraft was reported to increase the refresher training required by about one hour over that amount received if no flying is performed. For utility refresher aircraft, refresher training was increased from 6.8 for nonflying to 8.0 hours for minimums in light aircraft. If minimums were flown in utility aircraft, however, refresher training was reduced to 5.4 hours. It should be noted

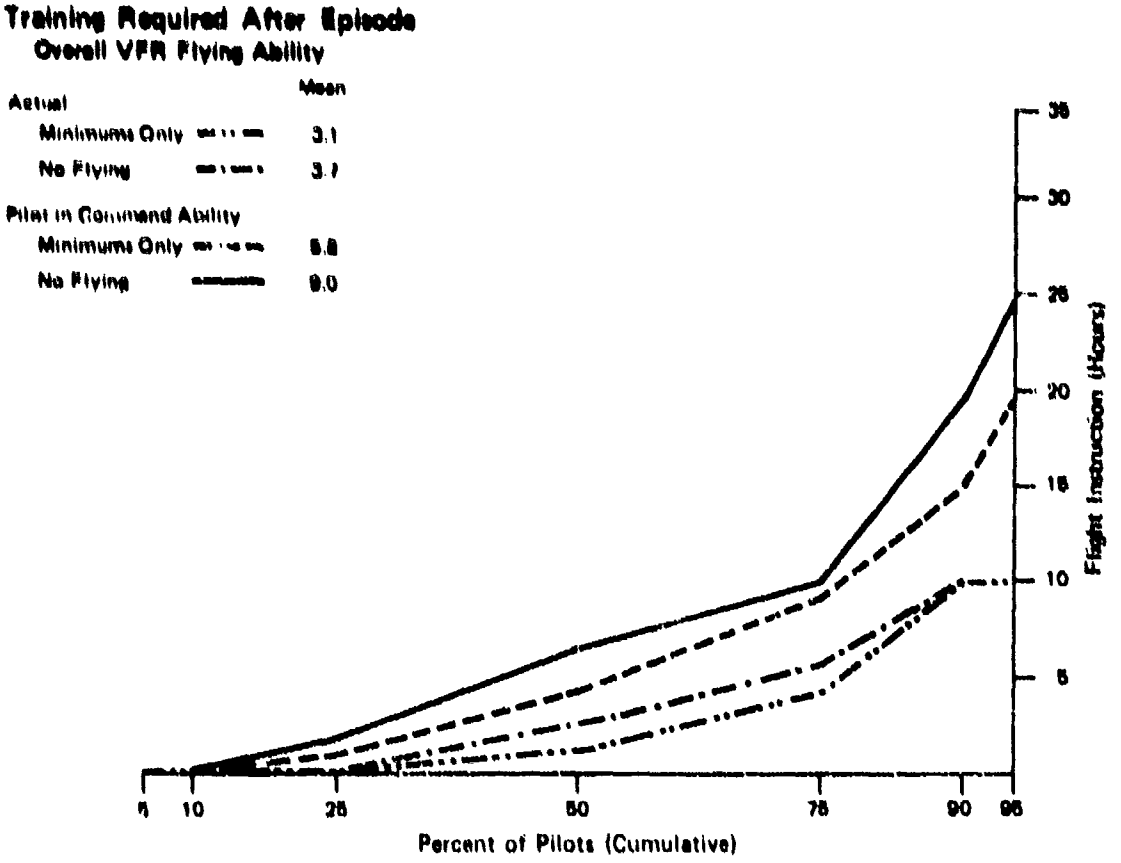


Figure 17

that for utility aircraft a large percentage of refresher training was in the same type of aircraft used for minimums, while this was not the case for light aircraft.

Therefore, it may be concluded that flying minimums in operational aircraft would reduce refresher training requirements in operational aircraft by at least one and one-half hours in comparison to nonflying, while flying minimums in light aircraft actually increased refresher training required in operational aircraft over that for non-flying by one and one-fourth hours.

Training Required After Episode
Overall IFR Flying Ability

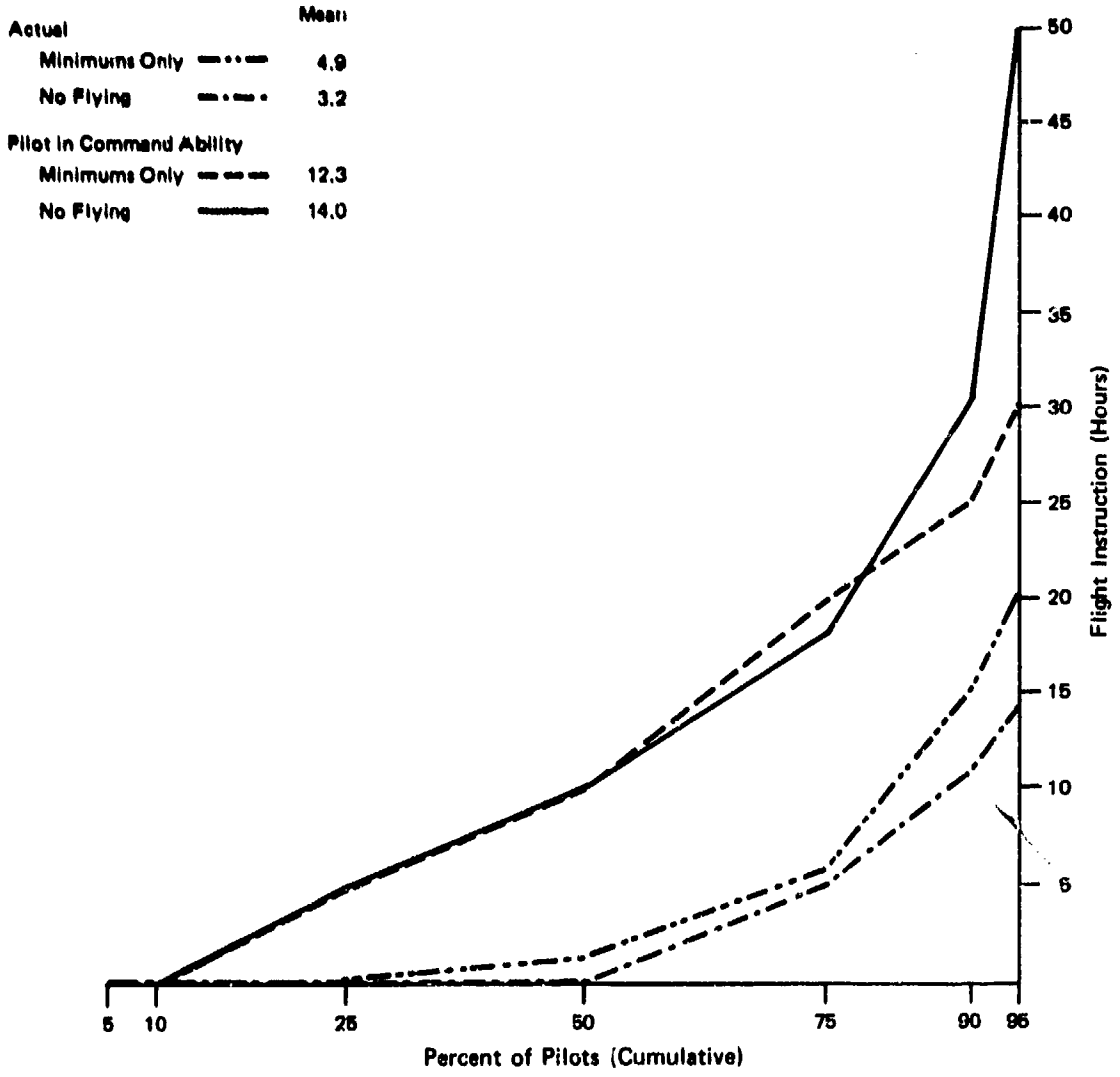


Figure 18

Training Required After Episode

Knowledge of the Aircraft and Preflight Procedures

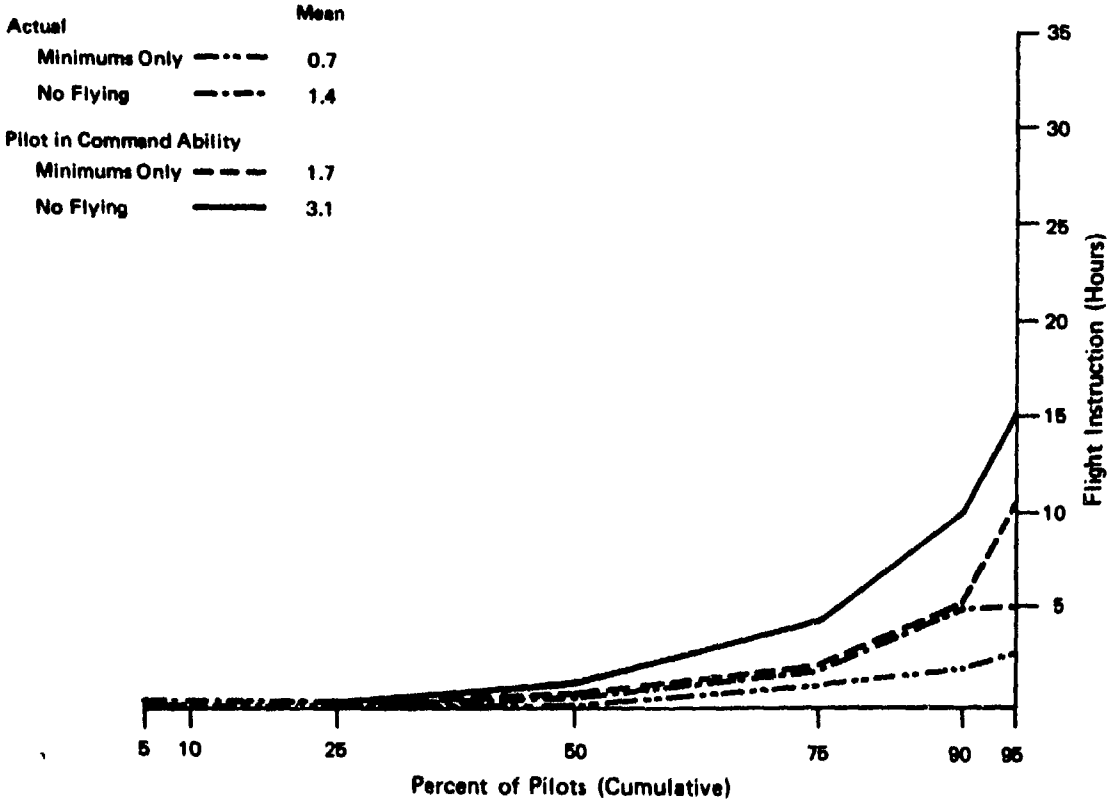
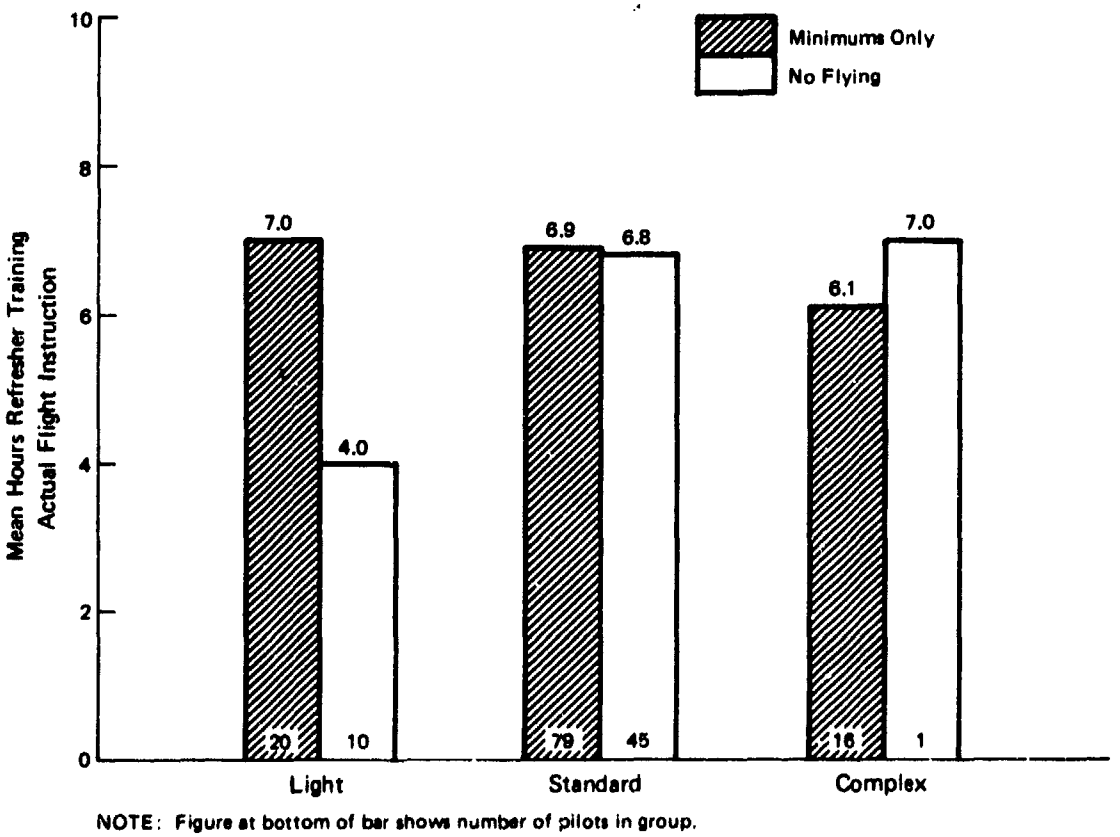


Figure 19

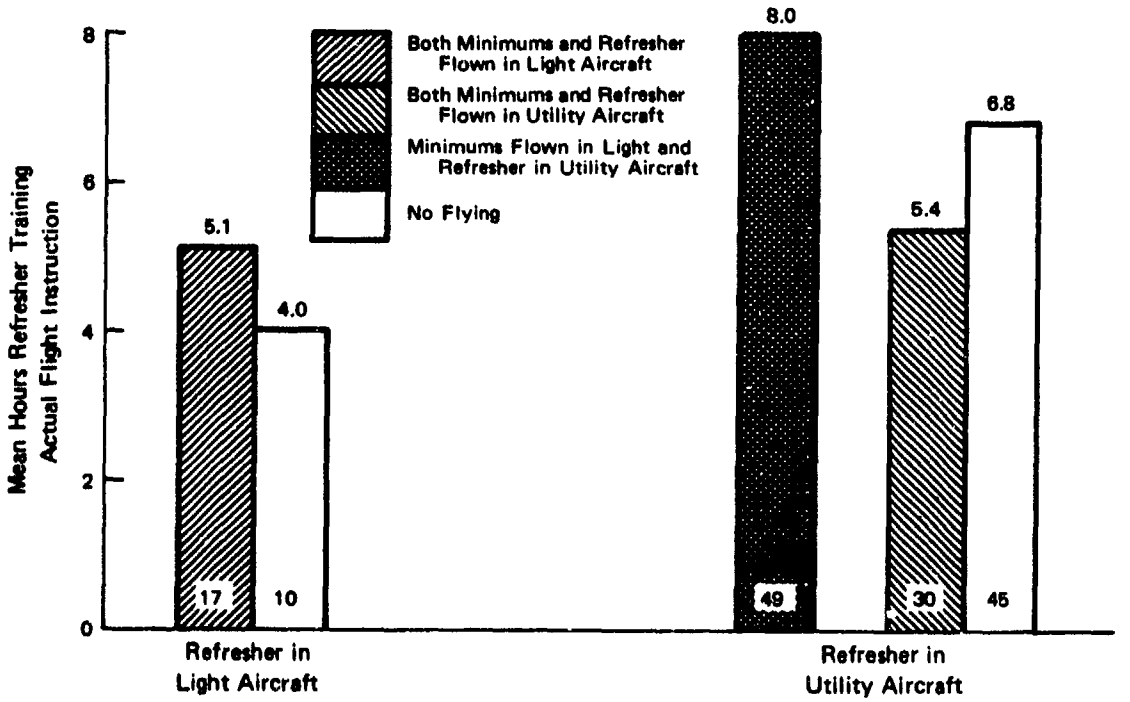
Effect of Type of Refresher Aircraft on Actual Refresher Flight Instruction



NOTE: Figure at bottom of bar shows number of pilots in group.

Figure 20

Effect of Type of Aircraft Used for Proficiency Flying on Hours of Refresher Flight Instruction



NOTE: Figure at bottom of bar shows number of pilots in group.

Figure 21

Chapter 4

DISCUSSION

TRAINING FOR COMBAT READINESS

The shape of the flying ability retention curves (see Figure 3) has major implications both for proficiency training and for combat readiness training. The fact that these curves generally conform with the retention curves that have been obtained for Navy jet pilots and laboratory data obtained for a variety of types of skills, permits high confidence in concluding that retention of Army aviator flying skills is generally comparable to other types of flying skills, and to skills in general. This, in turn, permits greater confidence in conclusions through application of the much more extensive general literature on retention and reacquisition of skills.

With respect to combat readiness training, for which the minimum objective for an aircraft crew is around the 6- to 7-level on the flying ability scale used in this study, the steeply dropping part of the retention curve applies. It is an obvious conclusion from this steep initial drop that frequent regular practice is required to maintain flying skills at or above this high ability level.

For proficiency training, however, where the purpose is to provide a unit with pilots of at least 3-level and hopefully 5-level ability, the lower asymptotic part of the curves apply. For VFR skill, the asymptotic level around 4.5 indicates that most pilots who do no flying should be equal to or better in flying ability than typical initial entry course graduates. For IFR skill, however, examination of Appendix B indicates that the average pilot has about one rating unit less flying ability after a minimum or nonflying episode than he had when he was graduated from his initial entry flight training course. Examination of Figure 3 supports this, with the *average* IFR ability asymptote very close to the minimum acceptable 3-level.

The fact that IFR ability is also very close to this level, even if minimums are flown, suggests that a larger amount or a better quality of proficiency flying is needed to maintain IFR ability significantly above the minimum acceptable 3-level. There are a variety of indications that improvement in the quality of proficiency flying could improve IFR ability substantially. Less emphasis on "boring holes in the sky," which has been typical of much of the past proficiency flying, and more practice in difficult IFR procedures could improve the situation significantly. Effective use of good synthetic training devices could also alter the situation.

The fact that little additional loss in ability reportedly occurs after six months of no flying, however, indicates that additional nonflying time will be obtained "free" in terms of refresher training requirements. Rather than fighting the steep part of the retention curve as combat readiness training must, proficiency flying policy should be arranged to exploit the level symptotic part of the retention curve.

LEAST-COST PROFICIENCY FLYING POLICY

The shape of the retention curve clearly dictates that the most economical proficiency flying policy for periods in excess of six months would be one that eliminated

proficiency flying entirely, followed by refresher training just prior to resumption of operational flying duties. This would take advantage of the asymptote of the retention curve, and by massing refresher training just prior to operational flying duty, would assure maximum transfer where the steep part of the curve applies. It should be noted that this refresher training should be given after, not before, any enroute delays and leave, since a month or six weeks' delay in the steep part of the curve would result in substantially less transfer of training.

LOW-COST SYNTHETIC TRAINING

There is one possible proficiency training option that might alter the above conclusions regarding most economical proficiency training policy—that of very low-cost synthetic instrument training in devices having high control and display layout fidelity with that of the subsequent duty aircraft. This would have to be a very simple, reliable, low-power device that would operate without instructor support and be feasible for use in almost any Army unit. To be cost-effective, it would need to operate at around $5 or less per training hour, and devices that should operate well below this value appear to be feasible with current training and device technology. The feasibility of this cost goal is indicated by a "personal" general aviation fixed-wing training device, now being marketed with training program tapes, that sells for about $1,000.[1]

The tradeoff functions relating training value per training device cost unit do not exist for this type of device in the Army training context, or for other concepts between this and highly sophisticated training devices such as the Synthetic Flight Training System (SFTS). It is likely that the $1,000 device/program could provide much of the needed instrument proficiency training very economically if it could be developed for Army aircraft.

If a set of aircraft-specific, low-cost training devices were developed, along with a training program for their use by experienced pilots who need to maintain or improve their flying ability, then a cost-effective proficiency flying program that would significantly improve overall flying proficiency and reduce refresher training requirements might be possible. Perhaps such a cost-effective proficiency flying program could be developed using a family of low-cost and sophisticated synthetic training devices or perhaps actual aircraft together, while it is very unlikely that a proficiency program cost-effective with excusal plus refresher training could be developed using only a sophisticated training device or actual aircraft.

GENERAL CONCLUSIONS

The results of this survey show that the form of the retention curve for flying skills is similar to that obtained for most other skills studied in the laboratory. Initial loss is rapid after training or experience, with most of the loss occurring within the first year. For flight excusal, periods beyond one year are obtained almost free in terms of refresher training costs.

Instrument flying skills deteriorate *below* a minimum acceptable level of flying ability for performing operational flying duties within one year for about one-half of Army aviators whether minimums are flown or not, whereas contact flying skills remain

[1] ATC-510 Simulator by Analog Training Computers, Inc., and Coordinated Instrument Rating Program developed for it by Jeppeson and Company. Mention of various equipments or products does not imply endorsement by the Department of the Army or HumRRO.

above this minimum acceptable level whether minimums are flown or not. Considering probable transfer of instrument training to contact skills, most proficiency or refresher training should be devoted to instrument flying skills. This, in turn, makes synthetic instrument training devices prime contenders for the most cost-effective proficiency or refresher training technique.

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AND
APPENDICES

LITERATURE CITED

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Appendix A

HEADINGS OF BACKGROUND INFORMATION AND FLYING EXPERIENCE ITEMS

Part I. BACKGROUND DATA

1. Date: _____

2. Name: _____ 3. SS Number: _____

4. Rank: _____ 5. Branch: _____ (e.g., Armor) 6. Age: _____

7. Civilian Flying Experience:
   a. Fixed Wing Single Engine Hours _____; b. Fixed Wing 2 or 4 Engine Hours _____;
   c. Fixed Wing Instrument Hours _____; d. Rotary Wing Hours _____.

8. If you have experienced a NO FLYING EPISODE of six months or longer, give the starting and end dates of the episode.

Start	End

9. If you have experienced a MINIMUMS ONLY EPISODE of six months or longer, give the starting and end dates of the episode.

Start	End

10. If you have experienced a NO INSTRUMENTS EPISODE of six months or longer, give the starting and end dates of the episode.

Start	End

11. Estimated total synthetic trainer hours: _____

Part II. CHRONOLOGICAL ASSIGNMENT OUTLINE SINCE BECOMING A RATED ARMY AVIATOR

INSTRUCTIONS—For each major assignment, provide the information requested by column headings.

Assignment	Starting Date of Assignment	Length of Assignment in Months	Type of Unit	Country or State	Type of Mission Flown Most Frequently	Type of Aircraft Flown Most Frequently	Estimated Avg. Hours Flown Per Mo.	
							VFR	IFR

Part III. SUMMARY OF GENERAL FLYING EXPERIENCE

INSTRUCTIONS—Enter the information requested by the column headings. Complete column 4b, 4c, or 4d only for the type(s) of episode(s) you have actually experienced.

1. List Aviator Ratings and Aircraft Qualifications in the Order Obtained	2. Enter Type of Aircraft in Which Obtained	3. Enter Date Rating or Qualification Obtained	4. Enter Total Hours and Total IFR Hours in Each Type of Aircraft Listed in Column 2							
			a. At the Present Time		b. At Start of NO FLYING Episode, *if experienced*		c. At Start of MINIMUMS ONLY Episode, *if experienced*		d. At Start of NO INSTRUMENTS Episode, *if experienced*	
			Total	IFR	Total	IFR	Total	IFR	Total	IFR

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Part IV. FLYING EXPERIENCE BEFORE, DURING, AND AFTER EPISODES OF NO FLYING, MINIMUMS ONLY, OR NO INSTRUMENTS

INSTRUCTIONS—1. Complete this part only for the type(s) of episode(s) you have experienced.

2. For each type of aircraft listed in Column 1, enter the total and IFR flying, if any, during the periods defined in Columns 2 through 7

1. Type of Aircraft Flown in Two Years Before Episode, During Episode, or For Refresher Training	2. Flying Experience in 12 Month Period 24 to 12 Months Before Start of Episode		3. Flying Experience in 6 Month Period 12 to 6 Months Before Start of Episode		4. Flying Experience in 3 Month Period 6 to 3 Months Before Start of Episode		5. Flying Experience in 3 Month Period From 3 Months Before Episode Until Start of Episode		6. Flying Experience During Episode		7. Refresher Training After Episode	
	Total	IFR	Total	IFR	Total	IFR	Total	IFR	Total	IFR	Total	IFR

Appendix B

MEANS, STANDARD DEVIATIONS, AND PERCENTILE DISTRIBUTIONS, BY SKILLS AND CRITERION MEASURES

The flying skills and criterion measures used in this Appendix are defined on pages 9 and 11 of the text of the report.

SKILL 0. OVERALL FLYING ABILITY

	CRITERION MEASURES	MEAN	SD	N	MIN	5%	10%	25%	50%	75%	90%	95%	MAX
0.1	When First Rated												
	Minimums	52.0	14.4	117	30	30	35	40	50	60	70	80	90
	No Fly	43.8	9.2	58	30	30	35	40	40	50	60	60	75
0.2	Before Ability Rating												
	Minimums	73.0	11.9	116	31	50	60	70	76	80	80	90	100
	No Fly	70.6	14.5	58	30	40	50	65	74	80	85	87	90
0.3	After Ability Rating												
	Minimums	47.3	13.8	116	25	30	30	40	45	58	65	70	95
	No Fly	43.3	17.2	58	10	25	20	35	40	58	70	70	85
0.4	Drop In Ability												
	Minimums	26.3	14.8	115	0	0	5	19	20	38	45	50	61
	No Fly	27.3	16.0	58	0	0	9	29	27	40	56	60	60
0.5	Actual: Academic or Cockpit												
	Minimums	3.4	5.8	108	0	0	0	0	1	5	10	10	50
	No Fly	5.6	8.6	49	0	0	0	0	1.5	8	15	25	40
0.6	Actual: Flight Instruction												
	Minimums	4.2	5.6	109	0	0	0	1	3	6	12	17	25
	No Fly	5.8	5.6	52	0	0	0	1	4	10	12	15	20
0.7	Actual: Supervised Operational Flying												
	Minimums	4.9	6.0	109	0	0	0	0	1.5	5	10	20	30
	No Fly	5.5	8.4	50	0	0	0	0	2.1	8	10	25	40
0.8	Initial: Academic or Cockpit												
	Minimums	3.5	6.0	108	0	0	0	0	1	4	10	15	35
	No Fly	3.3	5.0	52	0	0	0	0	1	4	8	15	25
0.9	Initial: Flight Instruction												
	Minimums	4.2	6.2	106	0	0	0	0	1	5	13	20	25
	No Fly	4.9	7.2	51	0	0	0	0	2	7	15	15	40
0.10	Initial: Supervised Operational Flying												
	Minimums	3.9	7.2	106	0	0	0	0	0	5	10	15	55
	No Fly	3.5	4.6	49	0	0	0	0	1	5	10	12	17
0.11	Pilot In Command: Academic or Cockpit												
	Minimum	7.5	9.6	111	0	0	0	1	3.5	10	20	20	50
	No Fly	9.3	9.8	49	0	0	0	2	5	15	20	35	40
0.12	Pilot In Command: Flight Instruction												
	Minimums	10.6	12.0	113	0	0	0	1	10	15	20	25	75
	No Fly	16.0	15.5	49	0	0	0	6	15	20	25	35	100
0.13	Pilot In Command: Supervised Operational Flying												
	Minimums	9.9	13.9	110	0	0	0	0	5	15	25	25	100
	No Fly	14.2	12.5	51	0	0	0	5	15	20	28	40	50

SKILL 1. OVERALL VFR FLYING ABILITY

	CRITERION MEASURES	MEAN	SD	N	MIN	5%	10%	25%	50%	75%	90%	95%	MAX
1.1	When First Rated												
	Minimums	54.0	14.2	114	30	35	40	40	50	60	75	80	90
	No Fly	46.0	10.8	58	30	32	34	40	40	50	60	68	80
1.2	Before Ability Rating												
	Minimums	75.0	12.3	116	30	50	60	70	77	80	90	90	100
	No Fly	73.2	14.6	58	30	40	50	70	80	80	85	90	100
1.3	After Ability Rating												
	Minimums	50.3	13.4	115	30	30	35	40	50	65	80	80	95
	No Fly	46.6	18.2	58	20	20	22	30	45	60	70	80	85
1.4	Drop In Ability												
	Minimums	25.0	15.1	115	0	0	10	10	20	30	45	52	60
	No Fly	26.8	18.2	58	0	0	0	10	22	40	50	60	70
1.5	Actual: Academic or Cockpit												
	Minimums	1.6	5.3	101	0	0	0	0	0	1	4	5	50
	No Fly	2.3	4.7	47	0	0	0	0	0	2	6	10	25
1.6	Actual: Flight Instruction												
	Minimums	3.1	4.6	103	0	0	0	0	1.5	4	10	10	25
	No Fly	3.7	3.9	48	0	0	0	0	2	5.6	10	10	15
1.7	Actual: Supervised Operational Flying												
	Minimums	2.5	4.0	102	0	0	0	0	1	3	10	10	20
	No Fly	4.8	7.4	44	0	0	0	0	2	5	10	20	40
1.8	Initial: Academic or Cockpit												
	Minimums	1.0	1.9	100	0	0	0	0	0	1	2.5	5	10
	No Fly	1.5	3.3	50	0	0	0	0	0	2	7	10	15
1.9	Initial: Flight Instruction												
	Minimums	2.6	5.0	101	0	0	0	0	0	3	10	10	25
	No Fly	3.4	5.3	47	0	0	0	0	1	5	8	15	25
1.10	Initial: Supervised Operational Flying												
	Minimums	2.7	4.7	101	0	0	0	0	0	3	5	10	25
	No Fly	3.0	4.9	42	0	0	0	0	0	5	10	12	20
1.11	Pilot In Command: Academic or Cockpit												
	Minimums	2.2	4.1	103	0	0	0	0	1	2	7	10	20
	No Fly	5.1	7.4	48	0	0	0	0	2	7	15	20	35
1.12	Pilot In Command: Flight Instruction												
	Minimums	5.8	9.0	105	0	0	0	1	4	8	15	20	75
	No Fly	9.0	8.9	47	0	0	0	2	7	10	20	25	40
1.13	Pilot In Command: Supervised Operational Flying												
	Minim...	6.3	9.7	105	0	0	0	0	3	10	20	20	75
	No ...	9.1	11.4	44	0	0	0	0	5	10	25	30	50

SKILL 2. OVERALL IFR FLYING ABILITY

	CRITERION MEASURES	MEAN	SD	N	MIN	5%	10%	25%	50%	75%	90%	95%	MAX
2.1	When First Rated												
	Minimums	44.0	17.4	110	5	20	25	30	40	53	70	77	90
	No Fly	37.4	16.7	55	3	10	20	30	35	40	60	60	98
2.2	Before Ability Rating												
	Minimums	56.8	19.5	111	10	20	30	45	55	70	80	90	100
	No Fly	49.2	20.8	56	5	15	21	35	41	60	75	80	98
2.3	After Ability Rating												
	Minimums	34.8	15.9	111	0	10	15	24	35	43	55	60	85
	No Fly	30.2	17.6	56	0	0	10	20	30	40	55	60	70
2.4	Drop In Ability												
	Minimums	22.8	15.6	110	0	0	0	10	20	30	40	50	80
	No Fly	19.5	16.4	56	0	0	0	1	20	30	40	50	60
2.5	Actual: Academic or Cockpit												
	Minimums	4.3	10.9	99	0	0	0	0	1	4.5	10	10	100
	No Fly	2.6	4.6	44	0	0	0	0	0	5	8	10	25
2.6	Actual: Flight Instruction												
	Minimums	4.9	7.0	99	0	0	0	0	2	6	15	20	40
	No Fly	3.2	5.3	44	0	0	0	0	0	5	10.5	14	20
2.7	Actual: Supervised Operational Flying												
	Minimums	2.9	4.4	98	0	0	0	0	0	5	10	10	20
	No Fly	3.0	7.3	43	0	0	0	0	0	1	10	16	40
2.8	Initial: Academic or Cockpit												
	Minimums	4.7	5.4	98	0	0	0	0	3	5	10	15	25
	No Fly	3.1	4.1	44	0	0	0	0	1	5	10	10	15
2.9	Initial: Flight Instruction												
	Minimums	6.7	8.1	98	0	0	0	0	5	10	20	25	50
	No Fly	5.1	6.7	45	0	0	0	0	2	10	10	10	35
2.10	Initial: Supervised Operational Flying												
	Minimums	4.7	6.2	96	0	0	0	0	2	6	10	20	25
	No Fly	3.3	4.5	43	0	0	0	0	0	5	10	10	17
2.11	Pilot In Command: Academic or Cockpit												
	Minimums	8.6	11.6	98	0	0	0	2	6	10	15	20	100
	No Fly	9.4	11.0	43	0	0	0	0	8	10	20	35	50
2.12	Pilot In Command: Flight Instruction												
	Minimums	12.3	11.4	100	0	0	0	5	10	20	25	30	75
	No Fly	14.0	13.1	44	0	0	0	5	10	18	30	50	50
2.13	Pilot In Command: Supervised Operational Flying												
	Minimums	10.2	13.4	101	0	0	0	1	6	12	20	30	75
	No Fly	11.5	12.7	44	0	0	0	0	8	20	25	32	50

SKILL 3. KNOWLEDGE OF THE AIRCRAFT AND PREFLIGHT PROCEDURE

	CRITERION MEASURES	MEAN	SD	N	MIN	5%	10%	25%	50%	75%	90%	95%	MAX
3.1	When First Rated												
	Minimums	55.5	15.42	117	30	30	40	45	50	69	79	80	95
	No Fly	49.1	12.91	58	30	30	32	40	50	60	70	70	80
3.2	Before Ability Rating												
	Minimums	73.7	12.29	116	30	50	60	70	75	80	90	90	98
	No Fly	71.6	13.71	58	30	40	50	70	72	80	85	88	100
3.3	After Ability Rating												
	Minimums	52.0	15.16	115	30	30	32	40	50	60	70	75	95
	No Fly	50.1	18.96	58	10	20	30	35	50	61	80	80	85
3.4	Drop In Ability												
	Minimums	22.5	15.82	114	0	0	0	10	20	30	40	43	60
	No Fly	21.9	16.97	58	0	0	0	10	20	32	40	50	70
3.5	Actual: Academic or Cockpit												
	Minimums	1.0	1.71	105	0	0	0	0	.5	1	2	5	10
	No Fly	3.0	4.41	46	0	0	0	0	1	3	8	10	25
3.6	Actual: Flight Instruction												
	Minimums	0.7	2.27	102	0	0	0	0	0	1	2	3	20
	No Fly	1.4	2.34	45	0	0	0	0	.5	2	5	5	10
3.7	Actual: Supervised Operational Flying												
	Minimums	0.9	2.73	101	0	0	0	0	0	1	1.5	5	20
	No Fly	1.8	3.88	45	0	0	0	0	0	1	6	10	20
3.8	Initial: Academic or Cockpit												
	Minimums	1.4	2.14	105	0	0	0	0	.5	2	3	5	10
	No Fly	2.0	2.99	47	0	0	0	0	.5	2	6	10	10
3.9	Initial: Flight Instruction												
	Minimums	0.8	1.79	104	0	0	0	0	0	1	2	4	10
	No Fly	1.6	3.16	46	0	0	0	0	0	1	5	10	10
3.10	Initial: Supervised Operational Flying												
	Minimums	1.0	3.06	103	0	0	0	0	0	.5	3	5	25
	No Fly	1.5	3.64	46	0	0	0	0	0	1	4	8	20
3.11	Pilot In Command: Academic or Cockpit												
	Minimums	2.2	2.72	106	0	0	0	0	1	3	5	10	15
	No Fly	3.3	4.04	45	0	0	0	0	1.5	5	10	10	16
3.12	Pilot In Command: Flight Instruction												
	Minimums	1.7	3.34	103	0	0	0	0	0	2	5	10	20
	No Fly	3.1	5.03	44	0	0	0	0	1	4	10	15	20
3.13	Pilot In Command: Supervised Operational Flying												
	Minimums	2.3	6.07	106	0	0	0	0	0	2	10	10	50
	No Fly	2.3	3.99	47	0	0	0	0	0	4	6	10	20

SKILL 1a. VFR BASIC MANEUVERS

	CRITERION MEASURES	MEAN	SD	N	MIN	5%	10%	25%	50%	75%	90%	95%	MAX
1a.1	When First Rated												
	Minimums	55.8	16.4	115	4	35	40	40	50	70	80	80	93
	No Fly	48.1	11.1	58	29	31	35	40	50	50	70	70	75
1a.2	Before Ability Rating												
	Minimums	73.7	12.9	116	10	50	60	70	74	80	90	90	100
	No Fly	73.0	14.3	58	40	40	50	70	75	80	90	90	100
1a.3	After Ability Rating												
	Minimums	51.5	14.1	115	20	30	35	40	50	60	70	70	95
	No Fly	49.8	18.5	58	20	20	25	37	45	68	73	80	95
1a.4	Drop In Ability												
	Minimums	23.4	15.5	115	0	0	0	10	20	34	45	50	69
	No Fly	23.0	16.1	58	0	0	2	10	20	30	40	53	70
1a.5	Actual: Academic or Cockpit												
	Minimums	0.7	2.0	101	0	0	0	0	0	.5	1	5	15
	No Fly	1.7	4.2	45	0	0	0	0	0	1	5.5	6	25
1a.6	Actual: Flight Instruction												
	Minimums	1.5	3.1	103	0	0	0	0	1	2	5	5	20
	No Fly	3.4	3.8	45	0	0	0	0	2	4	10	10	15
1a.7	Actual: Supervised Operational Flying												
	Minimums	1.4	3.3	101	0	0	0	0	0	1	4	5	20
	No Fly	4.2	9.0	46	0	0	0	0	0	3	10	20	40
1a.8	Initial: Academic or Cockpit												
	Minimums	0.6	1.3	103	0	0	0	0	0	1	2	2	10
	No Fly	1.1	2.3	47	0	0	0	0	0	1	2	7	10
1a.9	Initial: Flight Instruction												
	Minimums	1.2	1.9	103	0	0	0	0	0	2	3	5	10
	No Fly	2.8	3.9	47	0	0	0	0	0	1	5	10	15
1a.10	Initial: Supervised Operational Flying												
	Minimums	1.4	3.3	102	0	0	0	0	0	1	3	5	25
	No Fly	1.7	3.0	45	0	0	0	0	0	3	5	10	10
1a.11	Pilot In Command: Academic or Cockpit												
	Minimums	1.2	2.1	103	0	0	0	0	.1	1	3	5	10
	No Fly	2.8	5.1	46	0	0	0	0	1	5	8	10	28
1a.12	Pilot In Command: Flight Instruction												
	Minimums	2.3	2.8	105	0	0	0	0	1.5	3	5	10	12
	No Fly	6.9	8.0	45	0	0	0	0	4	10	20	25	28
1a.13	Pilot In Command: Supervised Operational Flying												
	Minimums	2.7	4.6	105	0	0	0	0	1	3	10	10	25
	No Fly	5.9	8.5	45	0	0	0	0	3	6	20	20	40

SKILL 1b. VFR CROSS-COUNTRY--DAY AND NIGHT

	CRITERION MEASURES	MEAN	SD	N	MIN	5%	10%	25%	50%	75%	90%	95%	MAX
1b.1	When First Rated												
	Minimums	55.0	16.2	115	30	30	35	40	50	70	80	80	90
	No Fly	47.5	11.1	58	30	33	35	40	45	50	60	70	80
1b.2	Before Ability Rating												
	Minimums	75.1	12.7	116	32	55	60	70	75	82	90	95	100
	No Fly	73.6	14.4	58	40	40	50	70	78	83	90	90	100
1b.3	After Ability Rating												
	Minimums	56.2	15.5	115	22	32	40	43	55	70	80	80	95
	No Fly	56.3	18.6	58	30	30	30	40	50	70	80	85	90
1b.4	Drop In Ability												
	Minimums	19.2	15.2	115	0	0	0	10	20	30	40	45	60
	No Fly	17.9	13.1	58	0	0	0	10	20	30	35	40	50
1b.5	Actual: Academic or Cockpit												
	Minimums	0.5	1.3	104	0	0	0	0	0	.5	1	2	10
	No Fly	1.1	3.9	46	0	0	0	0	0	.5	2	6	25
1b.6	Actual: Flight Instruction												
	Minimums	0.8	2.3	102	0	0	0	0	0	1	2	5	20
	No Fly	1.4	2.7	46	0	0	0	0	0	2	3.5	10	10
1b.7	Actual: Supervised Operational Flying												
	Minimums	1.1	2.6	103	0	0	0	0	0	1	4	5	20
	No Fly	3.1	7.2	45	0	0	0	0	0	3.5	10	16	40
1b.8	Initial: Academic or Cockpit												
	Minimums	0.5	1.1	102	0	0	0	0	0	1	2	2	5
	No Fly	1.0	1.9	45	0	0	0	0	0	1	2	4	10
1b.9	Initial: Flight Instruction												
	Minimums	0.6	1.1	102	0	0	0	0	0	1	2	3	5
	No Fly	1.2	2.1	46	0	0	0	0	0	2	5	5	10
1b.10	Initial: Supervised Operational Flying												
	Minimums	1.0	2.7	104	0	0	0	0	0	.5	3	5	20
	No Fly	1.3	2.2	45	0	0	0	0	0	2	5	5	8
1b.11	Pilot In Command: Academic or Cockpit												
	Minimums	1.3	2.2	107	0	0	0	0	0	2	4	5	10
	No Fly	1.9	3.9	44	0	0	0	0	0	1	5	10	20
1b.12	Pilot In Command: Flight Instruction												
	Minimums	1.8	2.6	103	0	0	0	0	1	2	5	8	10
	No Fly	3.1	5.2	44	0	0	0	0	0	5	10	15	25
1b.13	Pilot In Command: Supervised Operational Flying												
	Minimums	2.6	5.0	105	0	0	0	0	0	4	6	10	40
	No Fly	3.9	6.7	45	0	0	0	0	1	6	10	10	40

SKILL 1c. VFR ADVANCED MANEUVERS/OPERATIONS

	CRITERION MEASURES	MEAN	SD	N	MIN	5%	10%	25%	50%	75%	90%	95%	MAX
1c.1	When First Rated												
	Minimums	53.1	16.5	115	20	30	34	40	50	70	75	80	90
	No Fly	44.0	11.9	58	29	30	30	34	40	50	60	70	70
1c.2	Before Ability Rating												
	Minimums	73.2	13.7	116	29	47	55	65	70	83	90	90	100
	No Fly	71.5	16.6	58	30	37	40	60	75	80	90	90	100
1c.3	After Ability Rating												
	Minimums	47.5	16.8	115	10	20	30	40	50	58	70	75	95
	No Fly	47.1	21.6	58	10	20	20	30	40	69	80	85	95
1c.4	Drop In Ability												
	Minimums	26.5	17.6	115	0	0	0	10	25	40	50	60	80
	No Fly	24.0	16.8	58	0	0	0	10	20	30	50	50	70
1c.5	Actual: Academic or Cockpit												
	Minimums	0.7	1.7	102	0	0	0	0	0	1	1.5	3	10
	No Fly	1.2	4.0	45	0	0	0	0	0	1	3	5	25
1c.6	Actual: Flight Instruction												
	Minimums	1.2	2.0	102	0	0	0	0	.5	1	2	6	10
	No Fly	2.2	3.3	46	0	0	0	0	1	4	5.5	10	15
1c.7	Actual: Supervised Operational Flying												
	Minimums	1.8	3.6	102	0	0	0	0	0	2	5	10	20
	No Fly	2.8	6.9	46	0	0	0	0	0	2	6	10	40
1c.8	Initial: Academic or Cockpit												
	Minimums	0.6	1.2	104	0	0	0	0	0	1	2	3	5
	No Fly	1.1	2.3	46	0	0	0	0	0	1	2	5	12
1c.9	Initial: Flight Instruction												
	Minimums	1.4	2.1	107	0	0	0	0	1	2	4	5	10
	No Fly	2.5	3.5	48	0	0	0	0	1	5	7	10	15
1c.10	Initial: Supervised Operational Flying												
	Minimums	2.0	3.9	107	0	0	0	0	0	2	5	10	25
	No Fly	1.8	2.7	45	0	0	0	0	0	4	5	6	10
1c.11	Pilot In Command: Academic or Cockpit												
	Minimums	1.3	2.3	101	0	0	0	0	0	2	5	5	10
	No Fly	2.1	5.6	46	0	0	0	0	0	2	5	5	35
1c.12	Pilot In Command: Flight Instruction												
	Minimums	2.8	3.9	108	0	0	0	0	1.5	5	8	10	25
	No Fly	5.7	7.0	47	0	0	0	1	4	10	12	20	40
1c.13	Pilot In Command: Supervised Operational Flying												
	Minimums	4.0	6.8	108	0	0	0	0	1	6	10	15	50
	No Fly	5.5	7.7	48	0	0	0	0	3	7	10	20	40

SKILL 1d. VFR POWER LIMITED OPERATIONS

	CRITERION MEASURES	MEAN	SD	N	MIN	5%	10%	25%	50%	75%	90%	95%	MAX
1d.1	When First Rated												
	Minimums	51.0	16.4	115	20	30	30	40	50	60	73	80	90
	No Fly	41.1	10.6	58	10	25	30	34	40	50	50	60	70
1d.2	Before Ability Rating												
	Minimums	73.4	13.1	116	32	50	60	70	70	80	90	90	100
	No Fly	69.5	17.5	58	20	25	42	60	70	80	86	90	100
1d.3	After Ability Rating												
	Minimums	48.3	16.1	115	10	25	30	40	48	55	70	80	95
	No Fly	46.4	20.4	58	0	20	20	30	40	50	72	80	95
1d.4	Drop In Ability												
	Minimums	25.7	17.6	115	0	0	4	10	22	35	50	52	89
	No Fly	23.3	15.8	58	0	0	0	10	20	33	40	50	70
1d.5	Actual: Academic or Cockpit												
	Minimums	0.5	1.6	101	0	0	0	0	0	.3	1	2	10
	No Fly	1.0	3.7	46	0	0	0	0	0	1	2	2	25
1d.6	Actual: Flight Instruction												
	Minimums	0.8	1.6	101	0	0	0	0	0	1	2	5	10
	No Fly	1.1	2.8	46	0	0	0	0	0	1	4	9	15
1d.7	Actual: Supervised Operational Flying												
	Minimums	1.4	3.4	98	0	0	0	0	0	4	0	10	20
	No Fly	2.6	7.0	45	0	0	0	0	0	1	10	12	40
1d.8	Initial: Academic or Cockpit												
	Minimums	0.5	1.1	102	0	0	0	0	0	1	2	2.5	5
	No Fly	0.9	1.8	46	0	0	0	0	0	1	2	6	8
1d.9	Initial: Flight Instruction												
	Minimums	1.2	1.9	103	0	0	0	0	0	2	4	5	10
	No Fly	1.7	2.8	47	0	0	0	0	0	2	5	6	15
1d.10	Initial: Supervised Operational Flying												
	Minimums	1.7	3.6	105	0	0	0	0	0	2	5	10	25
	No Fly	1.4	2.6	45	0	0	0	0	.5	1	3.5	8	10
1d.11	Pilot In Command: Academic or Cockpit												
	Minimums	1.2	2.4	101	0	0	0	0	0	1	3	5	15
	No Fly	2.2	5.8	45	0	0	0	0	0	2	5	10	35
1d.12	Pilot In Command: Flight Instruction												
	Minimums	2.5	3.4	103	0	0	0	0	1	4	6	10	20
	No Fly	3.9	6.0	45	0	0	0	0	2	5	10	10	35
1d.13	Pilot In Command: Supervised Operational Flying												
	Minimums	4.4	9.0	104	0	0	0	0	1	5	10	20	60
	No Fly	4.5	7.5	47	0	0	0	0	2	5	10	20	40

SKILL 1e. VFR LOW LEVEL FLIGHT AND NAVIGATION

	CRITERION MEASURES	MEAN	SD	N	MIN	5%	10%	25%	50%	75%	90%	95%	MAX
1e.1	When First Rated												
	Minimums	51.2	16.0	115	20	30	30	40	50	65	70	75	90
	No Fly	43.0	10.3	57	25	30	30	36	40	50	60	60	70
1e.2	Before Ability Rating												
	Minimums	73.7	13.2	116	39	50	50	70	72	80	90	90	100
	No Fly	71.5	15.3	57	40	40	50	60	75	80	88	90	100
1e.3	After Ability Rating												
	Minimums	52.1	16.0	114	10	30	35	40	50	60	70	80	95
	No Fly	50.0	19.6	57	20	20	20	30	50	70	70	80	85
1e.4	Drop In Ability												
	Minimums	22.0	17.1	114	0	0	0	10	20	33	50	50	70
	No Fly	21.5	15.1	57	0	0	0	10	20	30	40	50	60
1e.5	Actual: Academic or Cockpit												
	Minimums	0.2	1.1	101	0	0	0	0	0	0	.5	1	10
	No Fly	1.0	3.8	46	0	0	0	0	0	0	2	4	25
1e.6	Actual: Flight Instruction												
	Minimums	0.4	1.1	103	0	0	0	0	0	0	1	2	6
	No Fly	1.8	5.9	46	0	0	0	0	0	0	4	10.5	35
1e.7	Actual: Supervised Operational Flying												
	Minimums	0.8	2.6	101	0	0	0	0	0	0	1	5	20
	No Fly	2.9	8.3	46	0	0	0	0	0	1	4	20	40
1e.8	Initial: Academic or Cockpit												
	Minimums	0.4	0.9	102	0	0	0	0	0	0	2	2	5
	No Fly	0.7	1.6	45	0	0	0	0	0	1	2	2	8
1e.9	Initial: Flight Instruction												
	Minimums	0.7	1.2	105	0	0	0	0	0	1	2	3	5
	No Fly	1.6	2.8	46	0	0	0	0	0	2	5	6	15
1e.10	Initial: Supervised Operational Flying												
	Minimums	1.0	2.2	104	0	0	0	0	0	1	4	5	10
	No Fly	0.9	1.7	44	0	0	0	0	0	1	4	5	6
1e.11	Pilot In Command: Academic or Cockpit												
	Minimums	0.7	1.7	102	0	0	0	0	0	1	2	4	10
	No Fly	1.2	2.8	45	0	0	0	0	0	1.5	2	5	16
1e.12	Pilot In Command: Flight Instruction												
	Minimums	1.5	2.3	106	0	0	0	0	1	2	5	6	10
	No Fly	3.4	6.1	46	0	0	0	0	.5	5	10	10	35
1e.13	Pilot In Command: Supervised Operational Flying												
	Minimums	2.5	5.7	104	0	0	0	0	0	2	10	10	40
	No Fly	3.0	6.8	45	0	0	0	0	0	3.5	8	10	40

SKILL 1f. VFR EMERGENCIES

	CRITERION MEASURES	MEAN	SD	N	MIN	5%	10%	25%	50%	75%	90%	95%	MAX
1f.1	When First Rated												
	Minimums	54.3	15.8	115	20	30	35	40	50	66	80	80	90
	No Fly	43.9	10.4	57	20	30	30	40	40	50	55	60	80
1f.2	Before Ability Rating												
	Minimums	73.1	13.8	116	30	50	58	65	72	80	90	90	100
	No Fly	70.7	14.9	57	30	40	50	60	70	80	86	90	100
1f.3	After Ability Rating												
	Minimums	51.7	17.0	115	10	25	30	40	50	60	70	80	95
	No Fly	48.2	21.4	58	10	20	20	30	47	68	80	80	95
1f.4	Drop In Ability												
	Minimums	23.0	16.8	115	0	0	0	10	20	30	49	55	67
	No Fly	22.4	16.4	57	0	0	0	10	20	32	50	50	60
1f.5	Actual: Academic or Cockpit												
	Minimums	1.1	2.0	103	0	0	0	0	.5	1	2	5	10
	No Fly	1.7	4.1	46	0	0	0	0	0	1	5	8	25
1f.6	Actual: Flight Instruction												
	Minimums	1.6	3.3	104	0	0	0	0	1	1.5	4	5	25
	No Fly	2.7	5.8	46	0	0	0	0	1	2	6	10.5	35
1f.7	Actual: Supervised Operational Flying												
	Minimums	1.2	2.8	102	0	0	0	0	0	1	4	5	18
	No Fly	2.6	6.3	46	0	0	0	0	0	2.5	6	12	35
1f.8	Initial: Academic or Cockpit												
	Minimums	0.8	1.5	102	0	0	0	0	0	1	2.5	4	10
	No Fly	1.2	2.6	48	0	0	0	0	0	1	2	5	16
1f.9	Initial: Flight Instruction												
	Minimums	1.2	2.3	103	0	0	0	0	.5	1	3	4	15
	No Fly	2.0	3.0	48	0	0	0	0	1	2	5	7	15
1f.10	Initial: Supervised Operational Flying												
	Minimums	1.2	2.6	103	0	0	0	0	0	1	4	6	15
	No Fly	1.1	2.2	46	0	0	0	0	0	1	5	5	10
1f.11	Pilot In Commar Academic or Cockpit												
	Minimums	1.6	2.5	102	0	0	0	0	1	2	5	8	12
	No Fly	2.7	5.4	46	0	0	0	0	1	3	5	6	28
1f.12	Pilot In Command: Flight Instruction												
	Minimums	2.4	3.4	104	0	0	0	0	1	3	5	10	18
	No Fly	4.4	6.3	47	0	0	0	0	2	5	10	15	35
1f.13	Pilot In Command: Supervised Operational Flying												
	Minimums	2.6	4.9	104	0	0	0	0	0	2	8	15	25
	No Fly	2.5	3.9	47	0	0	0	0	0	4	5	10	20

SKILL 1g. ARMY AND CIVIL REGULATIONS FOR VFR OPERATIONS

	CRITERION MEASURES	MEAN	SD	N	MIN	5%	10%	25%	50%	75%	90%	95%	MAX
1g.1	When First Rated												
	Minimums	53.2	16.1	115	20	30	30	40	50	70	75	80	90
	No Fly	43.6	12.6	58	20	30	30	34	40	50	60	70	80
1g.2	Before Ability Rating												
	Minimums	69.0	14.4	116	33	40	50	60	70	80	86	90	100
	No Fly	64.5	15.9	58	30	34	40	50	70	75	80	86	95
1g.3	After Ability Rating												
	Minimums	52.2	16.6	115	0	25	30	40	50	60	70	80	90
	No Fly	45.0	19.0	58	10	20	20	30	40	60	70	80	85
1g.4	Drop In Ability												
	Minimums	17.3	16.5	115	0	0	0	0	15	23	40	50	70
	No Fly	19.4	14.7	58	0	0	0	10	15	30	40	40	50
1g.5	Actual: Academic or Cockpit												
	Minimums	1.0	1.7	102	0	0	0	0	0	2	2.5	4	10
	No Fly	2.3	4.4	44	0	0	0	0	.5	2	8	8	25
1g.6	Actual: Flight Instruction												
	Minimums	0.5	1.4	101	0	0	0	0	0	0	1	2	10
	No Fly	0.9	1.8	43	0	0	0	0	0	1	2	4	10
1g.7	Actual: Supervised Operational Flying												
	Minimums	0.7	1.9	101	0	0	0	0	0	0	2	5	10
	No Fly	1.6	3.5	44	0	0	0	0	0	1	10	10	14
1g.8	Initial: Academic or Cockpit												
	Minimums	1.2	2.2	100	0	0	0	0	0	2	4	5	12
	No Fly	2.0	3.1	47	0	0	0	0	1	3	5	10	10
1g.9	Initial: Flight Instruction												
	Minimums	0.7	1.9	100	0	0	0	0	0	0	2	4	10
	No Fly	0.9	1.9	44	0	0	0	0	0	1.5	2	5	10
1g.10	Initial: Supervised Operational Flying												
	Minimums	0.7	1.8	102	0	0	0	0	0	0	3	5	10
	No Fly	0.8	1.9	45	0	0	0	0	0	0	3	5	10
1g.11	Pilot In Command: Academic or Cockpit												
	Minimums	2.1	2.8	103	0	0	0	0	1	2	5	6	15
	No Fly	3.9	4.5	47	0	0	0	1	2	5	10	12	20
1g.12	Pilot In Command: Flight Instruction												
	Minimums	1.0	2.3	100	0	0	0	0	0	1	4	6	12
	No Fly	1.6	3.9	44	0	0	0	0	0	2	5	10	15
1g.13	Pilot In Command: Supervised Operational Flying												
	Minimums	1.4	2.6	101	0	0	0	0	0	2	5	8	10
	No Fly	1.9	4.1	46	0	0	0	0	0	2	5	10	20

SKILL 2a. IFR BASIC MANEUVERS

	CRITERION MEASURES	MEAN	SD	N	MIN	5%	10%	25%	50%	75%	90%	95%	MAX
2a.1	When First Rated												
	Minimums	49.2	16.2	110	5	30	30	40	48	60	70	78	85
	No Fly	40.5	17.5	56	3	4	20	30	40	50	60	70	98
2a.2	Before Ability Rating												
	Minimums	61.4	18.5	111	6	30	40	50	60	70	86	90	98
	No Fly	55.7	20.0	56	4	22	30	40	54	70	80	80	97
2a.3	After Ability Rating												
	Minimums	40.4	16.8	111	0	15	20	30	40	50	60	70	85
	No Fly	37.9	18.7	56	0	10	20	20	35	50	60	69	80
2a.4	Drop In Ability												
	Minimums	22.0	16.0	110	0	0	3	10	20	30	40	55	70
	No Fly	18.7	15.9	56	0	0	0	5	14	30	40	50	50
2a.5	Actual: Academic or Cockpit												
	Minimums	2.1	3.9	95	0	0	0	0	.5	2	5	10	20
	No Fly	2.0	4.4	42	0	0	0	0	0	2	6	8	25
2a.6	Actual: Flight Instruction												
	Minimums	3.0	4.4	96	0	0	0	0	1	4	10	10	20
	No Fly	2.0	3.7	44	0	0	0	0	0	2	10	10	15
2a.7	Actual: Supervised Operational Flying												
	Minimums	2.0	3.7	94	0	0	0	0	0	3	6	10	20
	No Fly	1.3	2.9	43	0	0	0	0	0	1	5	10	12
2a.8	Initial: Academic or Cockpit												
	Minimums	2.0	2.8	98	0	0	0	0	.5	3	5	10	10
	No Fly	1.8	2.8	41	0	0	0	0	0	2	5	7	12
2a.9	Initial: Flight Instruction												
	Minimums	4.3	7.2	97	0	0	0	0	2	5	10	12	50
	No Fly	3.4	5.3	45	0	0	0	0	1.5	4	10	10	25
2a.10	Initial: Supervisad Operational Flying												
	Minimums	2.7	4.8	99	0	0	0	0	0	4	8	10	25
	No Fly	2.5	3.8	42	0	0	0	0	0	3	10	10	10
2a.11	Pilot In Command: Academic or Cockpit												
	Minimums	3.4	4.2	99	0	0	0	0	2	5	10	10	20
	No Fly	5.3	7.8	40	0	0	0	0	2	6	15	16	40
2a.12	Pilot In Command: Flight Instruction												
	Minimums	7.5	10.6	100	0	0	0	1	4	10	20	20	75
	No Fly	8.6	11.8	44	0	0	0	1	4	10	20	30	50
2a.13	Pilot In Command: Supervised Operational Flying												
	Minimums	5.5	7.5	99	0	0	0	0	2	10	15	20	40
	No Fly	7.6	11.2	44	0	0	0	0	4	10	20	30	50

SKILL 2b. ARMY AND CIVIL REGULATIONS FOR IFR OPERATIONS

	CRITERION MEASURES	MEAN	SD	N	MIN	5%	10%	25%	50%	75%	90%	95%	MAX
2b.1	When First Rated												
	Minimums	49.2	18.3	110	0	27	30	35	49	70	70	80	85
	No Fly	40.8	16.7	55	2	10	20	30	40	50	60	70	80
2b.2	Before Ability Rating												
	Minimums	60.5	18.4	100	10	30	32	48	60	70	84	88	100
	No Fly	51.0	21.0	56	4	21	30	40	50	64	80	80	97
2b.3	After Ability Rating												
	Minimums	41.6	16.8	111	0	16	20	30	40	56	60	65	82
	No Fly	35.3	18.1	56	0	10	20	21	30	42	60	70	85
2b.4	Drop In Ability												
	Minimums	19.8	17.5	110	0	0	0	10	14	30	50	56	70
	No Fly	17.5	15.4	56	0	0	0	0	12	30	40	42	50
2b.5	Actual: Academic or Cockpit												
	Minimums	2.0	3.9	98	0	0	0	0	0	2	5	8	25
	No Fly	2.7	5.5	43	0	0	0	0	0	2	10	16	25
2b.6	Actual: Flight Instruction												
	Minimums	1.3	3.1	97	0	0	0	0	0	1	5	8	20
	No Fly	2.0	4.8	41	0	0	0	0	0	2	10	15	29
2b.7	Actual: Supervised Operational Flying												
	Minimums	1.2	3.2	96	0	0	0	0	0	0	4	10	29
	No Fly	1.9	4.4	42	0	0	0	0	0	0	10	15	29
2b.8	Initial: Academic or Cockpit												
	Minimums	2.9	4.2	98	0	0	0	0	2	5	6	10	25
	No Fly	3.7	5.8	43	0	0	0	0	2	5	10	10	37
2b.9	Initial: Flight Instruction												
	Minimums	1.5	3.2	96	0	0	0	0	0	2	4	5	20
	No Fly	2.1	4.4	40	0	0	0	0	0	2	5	10	29
2b.10	Initial: Supervised Operational Flying												
	Minimums	[illegible]	3.3	98	0	0	0	0	0	2	5	10	20
	No Fly	1.2	2.9	40	0	0	0	0	0	1	2	5	15
2b.11	Pilot In Command: Academic or Cockpit												
	Minimums	4.6	6.7	98	0	0	0	0	3	5	10	20	35
	No Fly	6.4	10.4	43	0	0	0	0	3	8	15	40	40
2b.12	Pilot In Command: Flight Instruction												
	Minimums	3.3	6.0	98	0	0	0	0	0	4	10	15	30
	No Fly	4.6	9.3	40	0	0	0	0	0	5	15	20	50
2b.13	Pilot In Command: Supervised Operational Flying												
	Minimums	3.1	5.7	98	0	0	0	0	0	4	10	15	30
	No Fly	5.5	11.9	42	0	0	0	0	0	5	14	30	50

SKILL 2c. IFR TERMINAL APPROACHES AND DEPARTURES

	CRITERION MEASURES	MEAN	SD	N	MIN	5%	10%	25%	50%	75%	90%	95%	MAX
2c.1	When First Rated												
	Minimums	49.1	17.2	109	10	20	30	35	50	62	72	80	95
	No Fly	49.6	17.5	54	3	5	20	35	40	50	60	70	80
2c.2	Before Ability Rating												
	Minimums	60.2	19.1	110	10	30	30	50	60	75	85	90	90
	No Fly	51.2	21.2	55	5	20	25	35	50	60	80	80	95
2c.3	After Ability Rating												
	Minimums	40.6	17.5	110	0	15	20	30	40	50	60	70	90
	No Fly	34.5	19.2	55	0	5	10	20	30	44	60	64	85
2c.4	Drop In Ability												
	Minimums	20.2	16.0	109	0	0	0	10	20	30	40	50	70
	No Fly	18.0	16.4	55	0	0	0	0	10	20	40	40	60
2c.5	Actual Academic or Cockpit												
	Minimums	1.6	2.7	94	0	0	0	0	0	2	5	8	15
	No Fly	2.1	4.6	43	0	0	0	0	0	2	8	10	25
2c.6	Actual Flight Instruction												
	Minimums	2.2	3.0	95	0	0	0	0	1	3	6	10	12
	No Fly	2.4	4.7	42	0	0	0	0	0	3	10	14	20
2c.7	Actual Supervised Operational Flying												
	Minimums	1.7	3.1	93	0	0	0	0	0	2	5	10	12
	No Fly	1.9	4.2	42	0	0	0	0	0	0	10	10	20
2c.8	Instrl Academic or Cockpit												
	Minimums	2.5	4.3	95	0	0	0	0	1	3	5	10	20
	No Fly	1.7	2.4	42	0	0	0	0	1	2.2	5	5	10
2c.9	Instrl Flight Instruction												
	Minimums	3.2	3.6	96	0	0	0	0	2	5	10	10	12
	No Fly	2.7	3.7	41	0	0	0	0	1	5	10	10	15
2c.10	Instrl Supervised Operational Flying												
	Minimums	2.7	4.3	98	0	0	0	0	0	4	10	20	25
	No Fly	2.1	3.2	28	0	0	0	0	0	4	5	10	12
2c.11	Pilot In Command: Academic or Cockpit												
	Minimums	4.0	4.7	96	0	0	0	0	2	5	10	10	20
	No Fly	4.2	7.0	42	0	0	0	0	2	5	10	15	40
2c.12	Pilot In Command: Flight Instruction												
	Minimums	5.5	5.9	98	0	0	0	1	5	10	12	20	25
	No Fly	7.4	9.6	41	0	0	0	2	4	10	20	20	50
2c.13	Pilot In Command: Supervised Operational Flying												
	Minimums	5.2	7.6	98	0	0	0	0	2	10	15	20	50
	No Fly	6.2	13.4	42	0	0	0	0	2	10	15	20	50

SKILL 2d. IFR CROSS-COUNTRY—DAY AND NIGHT

	CRITERION MEASURES	MEAN	SD	N	MIN	5%	10%	25%	50%	75%	90%	95%	MAX
2d.1	When First Rated												
	Minimums	51.5	17.1	106	10	25	30	40	50	70	72	80	85
	No Fly	40.4	18.6	54	0	3	20	30	45	50	60	75	200
2d.2	Before Ability Rating												
	Minimums	62.4	17.7	110	5	20	40	50	62	75	83	90	90
	No Fly	54.9	22.2	56	4	20	28	35	50	70	80	90	95
2d.3	After Ability Rating												
	Minimums	45.1	17.8	110	8	15	25	30	40	60	67	70	94
	No Fly	37.1	21.5	55	9	4	10	21	30	60	64	70	85
2d.4	Drop In Ability												
	Minimums	17.9	14.5	150	0	0	0	10	17	25	40	40	70
	No Fly	17.2	15.4	55	0	0	0	0	11	20	40	40	50
2d.5	Actual: Academic or Cockpit												
	Minimums	1.6	3.2	94	0	0	0	0	0	2	5	5	20
	No Fly	1.6	4.3	42	0	0	0	0	0	1	5	8	25
2d.6	Actual: Flight Instruction												
	Minimums	1.0	3.5	95	0	0	0	0	0	2	5	9	25
	No Fly	2.6	7.0	43	0	0	0	0	0	2	6	12.5	40
2d.7	Actual: Supervised Operational Flying												
	Minimums	1.3	2.9	93	0	0	0	0	0	1	4	7	15
	No Fly	2.4	7.1	40	0	0	0	0	0	1	4	10	40
2d.8	Instrl.: Academic or Cockpit												
	Minimums	1.9	2.7	94	0	0	0	0	1	3	5	5	15
	No Fly	2.1	3.7	42	0	0	0	0	0	4	5	6	15
2d.9	Instrl: Flight Instruction												
	Minimums	2.7	4.1	95	0	0	0	0	2	3	8	10	25
	No Fly	2.3	3.2	41	0	0	0	0	-	5	5	10	10
2d.10	Instrl: Supervised Operational Flying												
	Minimums	1.7	3.0	96	0	0	0	0	0	3	5	10	15
	No Fly	2.2	3.3	39	0	0	0	0	0	2	8	10	10
2d.11	Pilot In Command: Academic or Cockpit												
	Minimums	3.2	4.2	95	0	0	0	0	2	5	10	12	20
	No Fly	5.4	9.4	42	0	0	0	0	2	5	10	25	40
2d.12	Pilot in Command: Flight Instruction												
	Minimums	5.2	7.2	96	0	0	0	0	2.5	6	10	12	50
	No Fly	6.5	9.2	42	0	0	0	1	3	10	15	25	50
2d.13	Pilot In Command: Supervised Operational Flying												
	Minimums	3.8	5.3	97	0	0	0	0	2	5	10	15	25
	No Fly	7.0	10.4	41	0	0	0	0	3	10	20	30	50

SKILL 2e. IFR COMMUNICATIONS

	CRITERION MEASURES	MEAN	SD	N	MIN	5%	10%	25%	50%	75%	90%	95%	MAX
2e.1	When First Rated												
	Minimums	49.8	16.7	109	10	20	30	40	50	62	70	80	85
	No Fly	40.3	17.2	54	3	5	20	30	40	50	60	70	90
2e.2	Before Ability Rating												
	Minimums	60.8	19.2	110	5	30	35	50	60	70	85	90	100
	No Fly	50.2	22.3	55	4	20	20	30	50	65	80	90	100
2e.3	After Ability Rating												
	Minimums	42.1	18.1	109	0	10	20	30	40	55	65	70	95
	No Fly	36.5	19.5	55	0	10	20	20	30	50	60	70	85
2e.4	Drop In Ability												
	Minimums	19.4	15.8	108	0	0	0	10	19	30	40	55	70
	No Fly	15.2	13.7	55	0	0	0	1	10	20	40	40	50
2e.5	Actual: Academic or Cockpit												
	Minimums	1.2	2.2	96	0	0	0	0	0	1	4	5	10.5
	No Fly	2.0	4.5	42	0	0	0	0	0	1	6	10	25
2e.6	Actual: Flight Instruction												
	Minimums	1.1	2.5	96	0	0	0	0	0	1	3	6	25
	No Fly	2.2	7.0	43	0	0	0	0	0	5	3	10.5	40
2e.7	Actual: Supervised Operational Flying												
	Minimums	1.3	2.8	94	0	0	0	0	0	1	5	10	10.5
	No Fly	1.5	3.9	40	0	0	0	0	0	0	5	10	20
2e.8	Initial: Academic or Cockpit												
	Minimums	1.4	2.1	92	0	0	0	0	1	2	5	5	10
	No Fly	1.9	2.9	43	0	0	0	0	0	2	6	8	10
2e.9	Initial: Flight Instruction												
	Minimums	1.3	2.3	95	0	0	0	0	0	2	3.5	4	15
	No Fly	1.1	1.8	41	0	0	0	0	0	2	5	5	6
2e.10	Initial: Supervised Operational Flying												
	Minimums	1.6	3.3	97	0	0	0	0	0	2	5	7	20
	No Fly	1.4	2.9	40	0	0	0	0	0	2	5	10	10
2e.11	Pilot In Command: Academic or Cockpit												
	Minimums	2.7	5.4	95	0	0	0	0	1.5	3	9	15	15
	No Fly	4.0	6.6	43	0	0	0	0	2	5	10	10	40
2e.12	Pilot In Command: Flight Instruction												
	Minimums	2.1	3.3	96	0	0	0	0	1	3	6	10	15
	No Fly	4.2	8.7	42	0	0	0	0	1	5	10	10.5	50
2e.13	Pilot In Command: Supervised Operational Flying												
	Minimums	2.6	4.2	96	0	0	0	0	0	5	7	10	20
	No Fly	4.3	9.0	41	0	0	0	0	0	5	10	20	50

SKILL 2f. IFR EMERGENCIES

	CRITERION MEASURES	MEAN	SD	N	MIN	5%	10%	25%	50%	75%	90%	95%	MAX
2f.1	When First Rated												
	Minimums	46.2	16.7	108	0	20	30	40	45	60	70	75	85
	No Fly	38.7	16.6	54	3	4	10	20	40	50	60	80	80
2f.2	Before Ability Rating												
	Minimums	59.8	18.5	109	0	30	35	50	60	75	80	85	100
	No Fly	50.1	21.1	55	5	20	21	34	50	64	80	80	85
2f.3	After Ability Rating												
	Minimums	43.0	17.6	109	0	6	20	30	45	50	60	80	94
	No Fly	35.9	19.7	55	0	0	10	20	30	50	60	60	85
2f.4	Drop In Ability												
	Minimums	19.4	15.8	108	0	0	0	10	13	28	35	40	70
	No Fly	14.9	13.3	55	0	0	0	0	15	20	31	40	42
2f.5	Actual: Academic or Cockpit												
	Minimums	1.2	2.1	96	0	0	0	0	0	1	4	5	10
	No Fly	2.0	4.5	43	0	0	0	0	0	1	8	10	25
2f.6	Actual: Flight Instruction												
	Minimums	1.1	2.5	96	0	0	0	0	0	1	4	6	15
	No Fly	1.6	3.8	43	0	0	0	0	0	1	4.5	10	20
2f.7	Actual: Supervised Operational Flying												
	Minimums	1.0	2.4	94	0	0	0	0	0	1	3	7	10
	No Fly	1.4	3.8	42	0	0	0	0	0	0	5	10	20
2f.8	Initial: Academic or Cockpit												
	Minimums	1.8	2.5	94	0	0	0	0	1	2	5	8	10
	No Fly	1.1	3.2	42	0	0	0	0	0	2	3	5	20
2f.9	Initial: Flight Instruction												
	Minimums	1.3	2.3	95	0	0	0	0	1	3	5	10	15
	No Fly	1.5	2.9	43	0	0	0	0	0	2	5	5	15
2f.10	Initial: Supervised Operational Flying												
	Minimums	3.8	1.9	96	0	0	0	0	0	3	5	10	20
	No Fly	1.4	3.0	39	0	0	0	0	0	1	2	10	10
2f.11	Pilot In Command: Academic or Cockpit												
	Minimums	2.8	3.1	96	0	0	0	1.5	2	5	8	10	10
	No Fly	4.0	7.2	42	0	0	0	1	2	5	10	10	40
2f.12	Pilot In Command: Flight Instruction												
	Minimums	2.1	3.3	96	0	0	0	0	2	5	10	10	15
	No Fly	4.6	8.8	43	0	0	0	0	2	5	10	20	50
2f.13	Pilot In Command: Supervised Operational Flying												
	Minimums	3.4	5.7	96	0	0	0	0	1	5	10	20	30
	No Fly	4.4	8.9	42	0	0	0	0	1	4	10	20	50

SKILL 3a. KNOWLEDGE OF AIRCRAFT SYSTEMS AND PERFORMANCE

	CRITERION MEASURES	MEAN	SD	N	MIN	5%	10%	25%	50%	75%	90%	95%	MAX
3a.1	When First Rated												
	Minimums	54.8	15.8	114	20	30	36	40	50	70	80	80	90
	No Fly	45.2	13.3	58	5	30	30	40	44	50	60	70	75
3a.2	Before Ability Rating												
	Minimums	72.3	14.0	115	32	50	56	61	70	80	90	98	100
	No Fly	70.7	15.1	58	30	40	50	61	79	80	90	90	100
3a.3	After Ability Rating												
	Minimums	53.9	16.0	114	20	30	30	40	50	60	76	80	95
	No Fly	50.4	21.1	58	4	20	25	35	50	70	76	80	90
3a.4	Drop In Ability												
	Minimums	19.2	16.1	114	0	0	0	10	17	30	40	45	70
	No Fly	20.3	17.9	58	0	0	0	3	20	35	40	50	80
3a.5	Actual: Academic or Cockpit												
	Minimums	1.4	3.1	102	0	0	0	0	.2	1.5	5	5	25
	No Fly	3.3	5.7	47	0	0	0	0	1	3	10	16	25
3a.6	Actual: Flight Instruction												
	Minimums	0.8	1.6	103	0	0	0	0	0	1	2	5	10
	No Fly	1.2	2.1	46	0	0	0	0	0	1.5	5	5	10
3a.7	Actual: Supervised Operational Flying												
	Minimums	1.1	3.0	101	0	0	0	0	0	1	4	5	20
	No Fly	1.6	3.2	46	0	0	0	0	0	2	5	10	12
3a.8	Initial: Academic or Cockpit												
	Minimums	1.3	1.8	103	0	0	0	0	1	2	4	5	10
	No Fly	1.3	2.2	48	0	0	0	0	0	1.5	5	5	10
3a.9	Initial: Flight Instruction												
	Minimums	0.9	1.5	103	0	0	0	0	0	1	2	4	8
	No Fly	0.9	1.9	46	0	0	0	0	0	1	2	5	10
3a.10	Initial: Supervised Operational Flying												
	Minimums	1.2	3.0	104	0	0	0	0	0	1	3	5	20
	No Fly	1.2	2.3	46	0	0	0	0	0	1	2	5	10
3a.11	Pilot In Command: Academic or Cockpit												
	Minimums	2.4	3.6	107	0	0	0	0	1.5	3	5	8	25
	No Fly	4.3	6.0	48	0	0	0	0	2	5	10	20	25
3a.12	Pilot In Command: Flight Instruction												
	Minimums	1.7	2.6	105	0	0	0	0	.5	2	5	6	15
	No Fly	2.2	3.1	45	0	0	0	0	1	4	8	10	10
3a.13	Pilot In Command: Supervised Operational Flying												
	Minimums	2.3	4.5	105	0	0	0	0	0	2	10	10	25
	No Fly	4.3	6.0	48	0	0	0	0	0	2	[illegible]	10	25

SKILL 3b. PREPARATION AND FILING OF FLIGHT PLANS

	CRITERION MEASURES	MEAN	SD	N	MIN	5%	10%	25%	50%	75%	90%	95%	MAX
3b.1	When First Rated												
	Minimums	55.2	16.0	115	14	30	36	40	55	70	75	80	90
	No Fly	46.8	14.0	57	20	28	30	40	40	53	70	70	80
3b.2	Before Ability Rating												
	Minimums	70.7	15.3	116	20	40	50	61	70	80	90	90	100
	No Fly	66.2	16.9	57	30	32	40	50	70	80	85	86	100
3b.3	After Ability Rating												
	Minimums	54.2	16.0	115	5	30	30	40	51	65	73	80	93
	No Fly	50.3	19.1	56	15	20	25	36	50	63	75	80	90
3b.4	Drop In Ability												
	Minimums	17.5	14.3	115	0	0	0	10	10	30	40	40	60
	No Fly	16.9	15.8	56	0	0	0	0	12	30	33	50	60
3b.5	Actual: Academic or Cockpit												
	Minimums	0.8	1.4	103	0	0	0	0	.3	1	2	3	10
	No Fly	1.5	3.8	48	0	0	0	0	.5	1	3	5	25
3b.6	Actual: Flight Instruction												
	Minimums	0.3	1.1	102	0	0	0	0	0	0	1	1	9
	No Fly	0.5	1.7	46	0	0	0	0	0	0	1	2	10
3b.7	Actual: Supervised Operational Flying												
	Minimums	0.5	1.5	100	0	0	0	0	0	0	1	2	10
	No Fly	0.8	2.1	47	0	0	0	0	0	.5	2	4	10
3b.8	Initial: Academic or Cockpit												
	Minimums	0.8	1.3	101	0	0	0	0	.3	1	2	3	10
	No Fly	0.8	1.2	48	0	0	0	0	0	1	2	4	5
3b.9	Initial: Flight Instruction												
	Minimums	0.3	0.8	100	0	0	0	0	0	0	1	2	4
	No Fly	0.4	1.1	45	0	0	0	0	0	0	1	2	5
3b.10	Initial: Supervised Operational Flying												
	Minimums	0.4	1.0	100	0	0	0	0	0	0	2	2	5
	No Fly	0.6	1.8	45	0	0	0	0	0	0	2	4	10
3b.11	Pilot In Command: Academic or Cockpit												
	Minimums	1.4	2.0	105	0	0	0	0	1	2	4	5	10
	No Fly	1.7	2.6	48	0	0	0	0	1	2	4	6	15
3b.12	Pilot In Command: Flight Instruction												
	Minimums	0.6	1.6	100	0	0	0	0	0	0	2	2	12
	No Fly	0.7	1.7	45	0	0	0	0	0	0	2	2	10
3b.13	Pilot In Command: Supervised Operational Flying												
	Minimums	1.1	2.7	101	0	0	0	0	0	1	3	5	20
	No Fly	0.9	1.9	47	0	0	0	0	0	1	2	5	10

SKILL 3c. PREFLIGHT, STARTING, TAXI, AND RUNUP PROCEDURES

	CRITERION MEASURES	MEAN	SD	N	MIN	5%	10%	25%	50%	75%	90%	95%	MAX
3c.1	When First Rated												
	Minimums	58.5	14.9	114	30	38	40	47	58	70	80	83	90
	No Fly	48.5	14.5	57	3	32	33	40	47	55	70	76	80
3c.2	Before Ability Rating												
	Minimums	74.4	13.1	115	33	50	60	70	75	85	90	90	100
	No Fly	71.9	16.4	57	5	43	50	68	72	80	90	90	100
3c.3	After Ability Rating												
	Minimums	57.5	15.0	114	20	30	32	50	60	70	75	80	95
	No Fly	56.5	19.2	57	20	30	30	40	55	70	80	85	100
3c.4	Drop In Ability												
	Minimums	17.6	14.5	114	0	0	0	10	15	25	40	43	70
	No Fly	16.8	16.4	57	0	0	0	0	10	30	40	50	60
3c.5	Actual: Academic or Cockpit												
	Minimums	0.8	1.3	104	0	0	0	0	.5	1	2	2	10
	No Fly	1.6	3.8	46	0	0	0	0	.5	2	3	6	25
3c.6	Actual: Flight Instruction												
	Minimums	0.7	1.6	102	0	0	0	0	0	.5	2	3	9
	No Fly	1.0	1.8	44	0	0	0	0	.5	1	2	4	10
3c.7	Actual: Supervised Operational Flying												
	Minimums	0.7	1.7	101	0	0	0	0	0	1	2	5	10
	No Fly	1.5	3.6	45	0	0	0	0	0	1	2	10	20
3c.8	Initial: Academic or Cockpit												
	Minimums	0.7	1.2	100	0	0	0	0	0	1	2	2	10
	No Fly	0.9	1.3	46	0	0	0	0	.5	1	2	4	6
3c.9	Initial: Flight Instruction												
	Minimums	0.6	1.2	102	0	0	0	0	0	1	2	3	8
	No Fly	0.8	1.4	45	0	0	0	0	0	1	2.5	5	5
3c.10	Initial: Supervised Operational Flying												
	Minimums	0.8	2.0	100	0	0	0	0	0	1	2	4	15
	No Fly	0.7	1.6	45	0	0	0	0	0	.3	4	5	6
3c.11	Pilot In Command: Academic or Cockpit												
	Minimums	1.4	2.2	103	0	0	0	0	1	2	2	5	15
	No Fly	1.3	1.5	45	0	0	0	0	1	2	3	4	8
3c.12	Pilot In Command: Flight Instruction												
	Minimums	1.1	1.8	103	0	0	0	0	.5	1	3	5	10
	No Fly	1.7	2.2	44	0	0	0	0	1	3	5	5	10
3c.13	Pilot In Command: Supervised Operational Flying												
	Minimums	1.3	3.2	103	0	0	0	0	0	1	3	5	20
	No Fly	2.0	3.7	45	0	0	0	0	.5	2	6	10	20